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ABSTRACT

A survey instrument, Higher Education Economic Development Survey (HEEDS), designed to measure research administrators' perception of current involvement of state universities and land grant institutions in economic development, was developed and validated. The instrument consists of 56 items concerning presently occurring and normative economic development activities. Surveys (N=416) were mailed in the summer of 1989 (244 were eventually analyzed) to research administrators in higher education. Five factors accounting for 72.1% of the total variance emerged: (1) capacity building; (2) technology development; (3) research, analysis, evaluation; (4) human resource development; and (5) new business development. Each factor confirmed an underlying dimension theoretically included during developmental stages of the instrument. Multiple analyses of variance were also computed indicating that HEEDS does reflect the theoretical dimensions underlying its construction. The instrument is recommended for use by higher education administrators in assessing their institutions' unique economic development strategies. Contains 186 references. (GLR)

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VALIDATION OF HIGHER EDUCATION ECONOMIC DEVELOPMENT SURVEY INSTRUMENT WITH STATE UNIVERSITY AND LAND GRANT INSTITUTION RESEARCH ADMINISTRATORS

J. Henley Hethcox

A Dissertation
Submitted to
the Graduate Faculty of
Auburn University
in Partial Fulfillment of the
Requirements for the
Degree of
Doctor of Education

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VITA

James Henley Hethcox, son of Henley and Marie (Porcorallo) Hethcox, was born May 16, 1947, in Birmingham, Alabama. He attended parochial and public schools and graduated from Hueytown High School in 1965. He attended The University of Alabama, Georgetown University, and Cumberland Law School. He received his Bachelor of Arts degree (1971) and Master of Arts in Education degree (1977) from the University of Alabama, Birmingham. During his tenure at Winterboro High School, he earned a Class AA certificate in English and a Rank B certificate in gifted and talented from the University of Alabama, Birmingham. Since leaving secondary school teaching in 1985, his experience has been wide-ranging, from internships with the State Department of Alabama, J.C. Calhoun and Central Alabama Community Colleges, to graduate teaching assistant in Educational Foundations, Leadership, and Technology and graduate research assistant in the Economic Development Institute, to employment in the Academic Affairs Office of the Auburn University Athletic Department. He married the former Sarah Lynn Coker of Sylacauga, Alabama, on August 14, 1971. They have two daughters, Jennifer Lynn and Ashley Carol, and one son, James Alan.

DISSERTATION ABSTRACT

VALIDATION OF HIGHER EDUCATION ECONOMIC DEVELOPMENT SURVEY INSTRUMENT WITH STATE UNIVERSITY AND LAND GRANT INSTITUTION RESEARCH ADMINISTRATORS

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The purpose of this study was to develop and validate a survey instrument which would measure research administrators' perception of current involvement of state universities and land grant institutions in economic development. The final instrument, Higher Education Economic Development Survey (HEEDS), consisted of 56 items concerning presently occurring and normative economic development activities. Of 416 surveys mailed in the summer of 1989, 264 were returned and 244 were analyzed. The 64% rate of return provided a sufficient data base for statistical analyses.

A panel of three experts compared the items in the instrument with the requirements established in the review

of the literature. The item-objective congruence algorithm was applied to each item of HEEDS for content validity. Following the evaluation of content validity, a panel of eight judges, utilizing a technical review form, made independent evaluations of the face validity and technical quality of HEEDS.

Factor analysis, using SAS, was chosen as the initial data reduction technique to determine the basic dimensionality of the Presently Occurring Activity Scale of HEEDS. Five factors accounting for 72.1% of the total variance emerged: (1) Capacity Building; (2) Technology Development; (3) Research, Analysis, Evaluation; (4) Human Resource Development; and (5) New Business Development. Each factor confirmed an underlying dimension theoretically included during developmental stages of HEEDS.

Multiple analyses of variance were computed to determine if significant differences existed. At the .05 level of significance, position, undergraduate major, highest degree obtained, type of institution where highest degree was obtained, and type of institutional governance as MANOVA sources did not explain the observed variance in the five factor scores suggesting that there was as much heterogeneity within groups as in the complete sample.

TABLE OF CONTENTS

LIST OF TABLES vii

I. INTRODUCTION 1

II. REVIEW OF THE LITERATURE 40

III. RESEARCH METHODOLOGY 112

IV. DATA ANALYSIS AND RESULTS 127

V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS 156

REFERENCES 168

APPENDICES 183

A. Magnitude Estimations of Expressions of Frequency and Amount Used in HEEDS

B. Content Validation of the Literature Review

C. Technical Item Review Form and Cover Letter

D. Sample of HEEDS, Definition of Terms, and Cover Letter

E. VARIMAX Standardized Scoring Coefficients with Kaiser's MSA

F. Theoretical Factors of HEEDS Defined by Instrument Item Numbers

G. Reliability Estimates of A Priori Theoretical Factors

LIST OF TABLES

1. Item Responses of Panel of Experts and Item Acceptability for 57 Items of HEEDS 128

2. Validity Responses of Panel of Judges and Calculation of Index of Concordance for 56 Items of HEEDS 129

3. Summary of Survey Results 132

4. Survey Response Rates 132

5. Demographic Characteristics of Respondents to HEEDS with Respect to Governance, Position, Undergraduate Major, Highest Degree, Institution Where Highest Degree Was Obtained, Years of Experience, Age and Gender 134

6. Preliminary Eigenvalues and Percentages of Variance for Five Factors Extracted by Initial Factor Analysis on 56 Items of HEEDS 139

7. Correlations (x 100) Among the Five Factors . . 139

8. VARIMAX Factor Loading (x 100) Pattern Matrix . 140

9. Capacity Building 143

10. Technology Development 145

11. Research, Analysis, Evaluation 146

12. Human Resource Development 148

13. New Business Development 149

14. MANOVA of Factor Scores with Selected Main Effects: DEGREE . . 150

15. MANOVA of Factor Scores with Selected Main Effects: UNDERGRADUATE MAJOR 151

16. MANOVA of Factor Scores with Selected Main Effects: SCHTYPE 152

17. MANOVA of Factor Scores with Selected Main Effects: GOVERNANCE 153

18. MANOVA of Factor Scores with Selected Main Effects: POSITION 154

I. INTRODUCTION

Orientation to the Problem

Not since World War II has the triad of American government, universities, and industry felt such a competitive challenge as the one they face today (Bloch, 1986; Cohen & Zysman, 1987; Matthews & Norgaard, 1984). A global "knowledge explosion" has disrupted American economic productivity and emphasized a singular lack of coordination in American economic development policy (Bell, 1973; Botkin, Dimancescu, & Stata, 1982; Matthews & Norgaard, 1984). Others have maintained that the United States was not shifting from industry to services, but rather from one kind of industrial economy to another (Cohen & Zysman, 1987). Nonetheless, Matthews and Norgaard (1984) perceived a difference scale of priorities in an information society: "Education is a strategic resource for business and industry, and knowledge is the essential product" (p. vii). Translated into real terms the knowledge explosion meant that "new technology has produced about 90% of all human knowledge in the sciences in the last 30 years alone and that virtually all knowledge will double again in the next 10-15 years" (Bernstein, 1986, p. 2). In fact, the rapid

proliferation of information has contributed to innovation process technology and has increased the productivity of developing nations to such an extent that the authors of Global Stakes warned:

> We cannot lose this game because there is no place else to go . . . . It's not that we are getting worse. They are getting better. We have to compete on a fast track . . . . The amount of time available is both short and beyond our control. (Botkin et al., cited in Matthews & Norgaard, 1984, pp. 30-31)

Everyone, however, might not agree with the assessment that America was not getting worse. It was well documented that American universities, the primary creators and transmitters of knowledge and information, have experienced since the late 1960s significant declines in physical plants, libraries, laboratories, and research equipment (Bloch, 1986; Matthews & Norgaard, 1984). In the past 20 years the federal investment in university research plants (facilities, land, and equipment) has declined in real terms by 20% (Botkin et al., 1982, p. 11). In Research Universities and the National Interest, 15 university presidents noted the obsolescence of American university research facilities and the "inescapable connection between first-rate research equipment and first-rate research" and the "almost exclusive federal role through financial policy" (Ford Foundation, 1977, p. 6). Engineering programs housed in 30-year-old facilities were not unusual and the cost of upgrading university laboratories to industry standards could cost $1 billion to $4 billion with maintenance cost of

7% to 8% of the original purchase price per year (Matthews & Norgaard, 1984, p. 90). Botkin, Dimancescu, and Stata (1984) noted faculty load has increased engineering department student-faculty ratios to levels 40% greater than ten years ago, and they cited a National Association of State Universities and Land Grant Colleges (NASULGC) survey of twenty-nine of its member institutions that confirmed the greatest impact of student-faculty ratio increases were in engineering departments:

> From 1976 to 1981, the worst case, Pennsylvania State University, saw its ratio jump 93 percent, Michigan State 65 percent, Ohio State 63 percent. One campus, University of California at Davis, saw only 1 percent increase. Overall, however, the average increase for this sampling was 35 percent.
>
> All these conditions bring home the message that there is a capacity problem in some fields of higher education. This has direct bearing on the health of the economy. (p. 240)

The steepest decline, however, has occurred since the Reagan administration. Since the 1960s, public investment in commercial research and development has dropped drastically, 95% from its level two decades ago, and the amount of Gross National Product (GNP) spent on the national infrastructure dropped from 2.3% twenty years ago to 0.4% in the 1980s (Reich, 1988, p. 526). Katsinas (1987) noted the largest peacetime military build-up in American history, financed entirely through deficit spending, occurred during the Reagan administration. This massive deficit has diminished the ability of government to use deficit financing as its principal antirecessionary tool; has

reduced the capacity of government to make essential investments in education, training, infrastructure, and research and development; and has been a major factor in the rise in the value of the dollar between 1981-1985 that caused half of the U.S. trade imbalance during that period (Choate & Linger, 1986). In addition, the decrease in commercial research and development has been perceived as a direct result of huge federal deficit spending, drying up commercial investment capital (Drucker, 1989; Reich, 1988).

The inability of the federal government to implement and coordinate macro- and microeconomic policies effectively has raised another issue that continued to be hotly debated: national industrial policy (Bluestone, 1987; Botkin et al., 1982; Choate & Linger, 1986; Harris, 1983; Levine, 1984; Matthews & Norgaard, 1984; Wachtel, 1988). Matthews and Norgaard (1984) referred to the growing American reaction to global economic crises as "an incredible hodgepodge of legislation, policies, programs, and administrative mechanisms" and noted:

> Not only is there no national strategy, even basic coordination is rare . . . [Even] at local levels a bewildering array of "mini" systems [are] engaged in employment and training activities, typically with little coordination or even communication, much less comprehensive planning. (p. 108)

The maligned policy reflected American business and political short-term time schedules that tended to be "crises or fad oriented [reflecting] old interests rather

than encouraging new endeavors" (Matthews & Norgaard, 1984, p. 121).

The report of the President's Commission on Industrial Competitiveness, Innovations in Industrial Competitiveness at the State Level (1984, December), called for a national industrial policy, although it noted that the federal government's "cumbersome decision making ability [is not] well suited to intervene in what essentially is a free market economy . . . . Evidence is building to indicate that states are better suited to orchestrate economic development strategies" (p. v). In fact, more recent studies have emphasized that states have the ability to analyze and act on economic development strategies more competitively and with greater flexibility and innovation than the federal government (Choate & Linger, 1986; Clarke, 1986; John, 1987; Osborne, 1987). Hull (1985) extended the argument for a national industrial policy that focused on economic development by distinguishing "between the development of a strategic industrial policy and the means to implement that policy" and that called for "task groups of industry, government, and university experts [who] can usefully assess the current status, future prospects, and means to reach a chosen future from the existing present for each sector of industry" (p. 82).

Others have maintained that the lack of a coordinated national industrial policy in this country has been the

result of the traditional faith in the ability of the private sector to respond more innovatively to opportunities without restrictions that sometimes occurred with central control (Beachler, 1985; Blumenthal, 1988; Malecki, 1987). Former Governor of North Carolina, James B. Hunt, Jr., offered perhaps the best explanation for America's inability to coordinate and implement a national strategy of any kind, "The problem is that we still have essentially the same organizational structure for science and technology that was designed in 1945" (Botkin et al., 1982, p. 163). Choate and Linger (1986) in The High-Flex Society explained that the "real issue is not government managing business, but government managing government" (p. 167).

While Choate and Linger essentially agree with Governor Hunt's assessment that the American economy was in desperate need of fundamental restructuring, they observed that experiences of past decades indicated that "no simple, quick, or radical remedy can eliminate the multitude of chokepoints that are strangling U.S. economic and political processes," and described an economic recovery that "will come in incremental steps as problems are identified, specific remedies are applied, and effective actions are taken" (1986, p. 9):

> The nation must become a High-Flex Society--in which firms can innovate, invest, and quickly take a product or service from development to production to market domination and in which government can maintain an environment that facilitates whatever adjustments are

> needed and do so in a common-sense, socially responsible manner. (p. 9)

In addition to the emphasis on national coordination of economic development activities, Paul Wachtel, professor and chairman of the Department of Economics Graduate School of Business Administration at New York University, advocated that federal policy makers consider the "longer-run implications of macroeconomic policies, and improve policy coordination both within the federal government between the monetary and fiscal policy authorities and among the major industrial nations" (1988, p. 12). Thus, the evidence indicated that a workable national industrial policy should be based on federal government encouragement of individual state efforts aimed at interstate and regional economic development cooperation of a strategic needs assessment drawn from expert government, industry, and university leadership; second, a commitment on the part of that leadership to implement and coordinate individual state strategies at the regional level; and finally, a comprehension of long-range macroeconomic implications at the federal level that encouraged regional economic development initiatives on a global basis.

The responsibility at the national level to handle more effectively increased global competition, rapid technological changes, and a coordinated national strategy has shifted to the individual states through New Federalism policies (John, 1987). Already, states have taken the lead

from the federal government in promoting U.S. prosperity in the global market (Osborne, 1987). The opportunities for further state initiatives in coping with rapid technological change have required the development of a comprehensive, three-fold, integrated education-industry-government strategy that defines the supporting roles (Choate & Linger, 1986; Osborne, 1987; Sheppard, 1986). Effective implementation of policies of such magnitude required coordination, imagination, and resourcefulness in state economic development and, most importantly, a link to higher education (Bernstein, 1986; Johnson, 1984; New England Board of Higher Education [NEBHE], 1987). In fact, others looked particularly to higher education as a source of invention and technical entrepreneurship (Li, 1980; Stankiewicz, 1986) and as a stimulant for economic renewal by its acting as a conduit for long-term solutions to national problems (National Association of State Universities and Land-Grant Colleges [NASULGC], 1987; U.S. House of Representatives, 1971; U.S. Senate, 1968; White House Science Council [WHSC], 1986).

Long before New Federalism, one of the traditional objectives of state government had been to promote economic development (Digby, 1976; Eichner, 1970; Morrison, 1986). The most notable increases in state economic development initiatives in recent years have been aimed at attracting high technology companies (Bernstein, 1986; Malecki, 1987;

Office of Technology Assessment [OTA], 1983, 1984a, 1984b). And yet, Katsinas (1987) estimated that "in 1985 there were over 11,000 state, regional, county, township, and city industrial development authorities chasing after only 1,400 new plants" (p. 15). In light of such dismal attempts to attract high technology firms, the limitations of using only one strategy--industry chasing--for economic development became apparent. As Malecki (1987) noted: "Everyone wins when towns de-emphasize the traditional lures of low taxes, low wages, and limited unionization and instead improve their airport facilities, schools, research infrastructure, local entrepreneurship, quality of life, and training for technical workers" (p. 51).

A recent study of Hansen (1988), Economic Development and Regional Heterogeneity: A Reconsideration of Regional Policy for the United States, advocated capacity-building regional economic development policies that focused on "improvements in the quality of government, in the physical and social environment, in informal activities and networks, and especially, in human resource development" (p. 116). The role of higher education, in state economic development strategies was clarified further when Bernstein (1986) in Higher Education and the State: New Linkages for Economic Development asserted, "The single, most effective approach to strengthening state economic development is for states to

invest in education. Education in fact is the largest budget expenditure of the states" and he suggested:

> If states want to leverage their public monies to produce the greatest return, it is best done by strategic appropriations. . . . It is in higher education where the states can act most effectively as catalysts, leveraging their investments in scientific and technological research and training as the seed money to develop matching grants and contracts from industry. (p. 24)

In addition, Bernstein (1986) emphasized that "linking colleges and universities to economic development is the hallmark and the immediate future of every industrialized country, and many developing nations" (p. 13).

Some researchers have focused exclusively on the high-technology university-industry research component of economic development (Breslin, 1986; Flynn, 1986; Friese, 1984; Giovengo, 1986; Johnson, 1984; National Science Foundation [NSF], 1982; OTA, 1983, 1984a, 1984b; Watkins, 1985a, 1985b), while others aimed at identifying and analyzing university-industry research mechanisms promoting high technology (Baer, 1980; Logan, 1984; Melchiori, 1984; NSF, 1982; Peters & Fusfeld, 1983; OTA, 1983, 1984a, 1984b).

Still others have been helpful in delineating the various roles of higher education in economic development: fundamental guidelines for establishing the role of higher education in linking technology to economic development (Miller & Clark, 1983); issues in financing higher education (Hoy & Bernstein, 1982); a survey of trends in state coordination of higher education (Glenny, 1985); issues in

continuing adult education facing American higher education leadership involving economic development (Katsinas, 1987; Preer, 1984); the contributions to regional and state economic development by state universities and land grant institutions (Cantlon, 1985; Matthews & Norgaard, 1984); regional surveys of state legislators on the role of higher education in economic development (NEBHE, 1980, 1984, 1987); a survey of business, government, and higher education leaders on the role of higher education in economic development (National Conference of State Legislatures, 1984); American Association of State Colleges and University (AASCU) survey of factors influencing the involvement of higher education in economic development (AASCU, 1986a); a directory of economic development programs (AASCU, 1986b); a survey identifying the existing technology transfer network of state extension services (Clarke & Dobson, 1989); the role of urban universities in strategic economic development planning (Sheppard, 1986); the impact of American higher education on infrastructure and state economic redevelopment (Beachler, 1985); dimensions of new university roles in economic development (Chmura, 1987); ways to measure state economic performance through the involvement of higher education (Cognetics, 1988; Corporation for Enterprise Development, 1986, 1987; Grant Thornton, 1987); primary ways that states promote economic growth through involvement with higher education (Beyers, Johnson, & Stranahan, 1987;

Osborne, 1987); higher education policies and economic growth in the American States (Jones & Vedlitz, 1988); and an assessment of state science and technology policies designed to promote economic development through higher education involvement (Schmandt & Wilson, 1988).

Moreover, a comparative analysis of six statewide reports noted that each report made recommendations for additional funding for higher education primarily on the basis of a "close link between the health of the states' economy and the university" (Diabasio, 1986, p. 22).

The claim of interdependency between economic development and public education has long been a recognized factor (Bernstein, 1986; Botkin et al., 1982; Diabasio, 1986; Southern Growth Policies Board, 1986). Some disputed the existence of the relationship and claimed that higher education and state economic development activities are based on "assumptions of limited substantiation" (Miller & Clark, 1983, p. 1), and "information regarding the relationship between higher education and economic development is limited" (Beachler, 1985, p. 1). Others maintained that "despite numerous studies which have been carried out during recent years, our knowledge of the actual performance of different university-industry interfaces continues to be patchy . . ." (Stankiewicz, 1986, p. 96), and "while it would seem quite natural for the corporate side to conduct cost-benefit analyses, universities

typically have no good handle on evaluating the impact and utility of their commercial partnerships" (Melchiori, 1984, p. 21). Byron (1984) attributed the inability of higher education to provide information to its lack of a comprehensive database: "Most institutions are not doing strategic planning; some do not know how, others don't understand its value. However, most fail to plan because they don't have the database that can support a good management information system" (p. 28). He compared academia's lack of foresight in taking the lead in the information age to an era of early railroad dominance that became a trap restricting its perspective to the broader implications of transportation and observed, "If the education industry confines its vision to three-hour credit courses in four-walled classrooms over semester long segments of study, it will surely suffer the fate of the railroads" (Byron, 1984, p. 28).

What was evident, however, was that in 1984-85 the largest single source of revenue, outside of tuition, for higher education was the individual states--$31 billion (Bernstein, 1986, p. 25). Although both the legal responsibility (Collier, 1987) and the major financial responsibility (Bernstein, 1986) for higher education reside with state government, a major finding of a 1984 New England Board of Higher Education survey of state legislators was that the legislators indicated a lack of information

provided to them by higher education (National Conference of State Legislatures [NCSL], 1984). Furthermore, Bernstein complained that the lack of relevant data on public funding for higher education made it difficult to evaluate institutional performance and thus accountability, and he ironically acknowledged, "Universities are the most significant national depositories and transmitters of knowledge and information in our society--except perhaps about themselves" (p. 32). Neither have governors developed a "clear vision for higher education, nor even a specific agenda" (Bernstein, 1986, p. 4). The National Alliance for Business (NAB) urged "all key actors . . . to get their views out on the table and work toward a consensus on defining the problem and clarifying the objectives" (1984, p. 72).

Tornatzky (1983) lamented the lack of "well-grounded empirical or conceptual" attempts to describe the university/industry innovation process and noted that the "literature that does exist on university/industry technological interaction has been generally limited to case studies and anecdotes of 'success'" (p. 9). He explained:

> As any of you in universities know, here too the non-experimental "experiments" are already underway. University vice presidents for research are in an experimenting mood these days, with increasing pressure to replace declining Federal dollars with other sources of research funding. Again, real-time, well-instrumented attempts to systematically intervene in the unstructured, uncertain field of university/industry relations could yield untold

> beliefs in better harnessing the nation's intellectual capital. (1983, p. 9)

A National Science Board (NSB) field study conducted by Peters and Fusfeld (1983) described and assessed over 400 cases of university/industry interaction and identified factors that either nurtured or limited that interaction. They found a majority of university/industry interaction was less than three years old and had not had significant time to be evaluated based on their performance. Thus, a clear need existed for a comprehensive, well-defined economic development agenda that met the needs of business, government, universities, and communities. An agenda that was strategic in scope, developmental in setting priorities, and not biased towards any constituencies at the expense of others demanded objective research in order to clarify the emerging roles of each constituent and to assess the most suitable initiatives for each.

A key component of any successful state initiative to implement and coordinate economic development will include higher education (Beyers et al., 1987; Botkin et al., 1984; NASULGC, 1987; Osborne, 1987; Schmandt & Wilson, 1988; Sheppard, 1986; Stankiewicz, 1986). Lynton (1984) noted that initiating economic development strategies may have profound implications in higher education:

> The traditional model for academia, particularly for universities [is] characterized by considerable isolation from the outside world [with] . . . emphasis on basic research for its own sake and communication of results primarily to fellow scholars . . . [and] also

> characterized by internal boundaries: between liberal arts and professional subjects, between regular instruction and continuing education, between credit and non-credit programs, and between matriculated and special students. (p. 153)

While the need clearly existed for a comprehensive, well-defined economic development agenda that met the needs of businesses, governments, universities, and communities, a crucial question was: Will the emerging new roles of higher education institutions in economic development force all traditional institutions, whether they want to or not, to suddenly alter their mission? Perhaps there was no need. The strength of America is due in part to a university system that is more diverse and unique than any other in the world. Pat Cross at the Wye Plantation Conference observed:

> Higher education still is wedded to the prestige model of the research institutions which even community colleges seek to emulate. Since we can't ask all institutions to act alike, it is important for each to clarify its own role. (Cross cited in Preer, 1984, p. 6)

Notwithstanding this observation, societal needs demanded some public institutions encompass a full range of activities while others focused on one or two, depending upon interest and capacity (AASCU, 1986a). As a result, each type of postsecondary institution has been engaged in economic development to varying degrees in its respective states (Chmura, 1987). The state university and land grant institution missions have historically included public service and research as well as instruction and thus they have become models of the most adaptive existing vehicles in

higher education to meet increasing business, government, and community needs for involvement in economic development (Bernstein, 1986; Botkin et al., 1982; Lynton & Elman, 1987; Matthews & Norgaard, 1984; NASULGC, 1987).

The advent of the National Association of State Universities and Land Grant Colleges 104 years ago fostered a unique, innovative relationship between the American university system and the needs of society. In fact, the most consistent citation in the literature was the success of the land grant precedent in improving the efficiency of the American farmer beyond any prevailing standard (Bell, 1973; Botkin et al., 1982; Choate & Linger, 1986; Cohen & Zysman, 1987; Chmura, 1987; Hull, 1985; Lynton & Elman, 1987; Matthews & Norgaard, 1984; Osborne, 1987; U.S. Senate, 1965). Studies that related the unique role of state universities and land grant colleges in American higher education included the following: modeling a new university adaptable to rapid change on the level of the land grant institution (Matthews & Norgaard, 1984), modeling industrial extension programs after agricultural extension programs (Doyle & Brisson, 1985; General Accounting Office, 1983; Hull, 1985; Osborne, 1987; U.S. Senate, 1965, 1968), stimulating a proposal for a high technology Morrill Act (Botkin et al., 1982), suggesting guidelines for state colleges and universities to implement land grant techniques to foster economic development (Preer, 1984), reminding land

grant institutions to be more aware of state needs than the average public or especially the private university (Cantlon, 1985), and utilizing state university and land grant research institutions as designated state agencies to disseminate information and technical field agents to businesses and local governments (U.S. Senate, 1965).

What made the state university and land grant institution the appropriate model for incorporation and delivery of national/regional economic development objectives? The success of the agricultural cooperative extension program through the Smith-Lever Act of 1914 increased the level of farm productivity and reduced the need for farm labor, thereby providing additional manpower resources to fuel the subsequent industrial growth and the growing number of engineering/technical schools (Eddy, 1957; U.S. Senate, 1965). In addition, the success of agricultural extension during the early part of this century provided a framework for future industrial extension efforts (U.S. Senate, 1965) and the increasing reliance of individual states on their state universities and land grant institutions in this regard paved the way for future university-industry-government-community interaction (Moos, 1981; Osborne, 1987). The interdependency of these elements illustrated the need for coordination and delivery of a variety of technical assistance services to small businesses, communities, and developmental organizations

through institutions of higher education. Furthermore, the recognition of the need for a comprehensive delivery system of technical assistance played a major role in the passage of legislation to accomplish specific economic development objectives.

The Area Redevelopment Administration (ARA), begun in 1963 under legislation PL 87-27, was continued by its successor agency the Economic Development Administration (EDA) as PL 89-136, in an effort designed to mobilize university resources in solving economic development problems (Fatzinger, 1979). The university center program initiated by ARA was continued after its demise by EDA and by 1974 ARA-EDA had invested $17.5 million in forty-one consultant-type centers in universities in thirty-three states (Fatzinger, 1979, p. 59). ARA-EDA was aimed particularly at economically distressed rural areas and focused almost exclusively on minorities (Fatzinger, 1979).

The passage of the State Technical Services Act of 1965 (PL 89-182) found that utilizing higher education institutions linkages and one-on-one consulting were crucial elements of agreement with ARA-EDA in providing technical assistance to small businesses and communities. However, while ARA-EDA was more parochial, the State Technical Services (STS) program was more comprehensive in its approach to economic development and technology transfer.

In testimony before the U.S. Senate, Thomas Marshall Hahn, then President of Virginia Polytechnic Institute and now CEO of Georgia-Pacific Corporation, speaking on behalf of the National Association of State Universities and Land Grant Colleges emphatically noted the impact of the land grant cooperative agriculture extension movement a century ago as the "principal ingredient in the success of our industrial economy because we can release most of our labor force for manufacturing" (U.S. Senate, 1965, p. 103). In the initial hearings of PL 89-182, Congressman J. Mackay (D-GA) registered concern over the connotation of the term "technical" that might have restricted the program from aiding businesses except in the area of science and engineering (U.S. House of Representatives, 1965).

Not only were the agencies designated by the states to implement and coordinate the State Technical Services Act of 1965 predominantly colleges and universities (74%), but the largest segment of this group was comprised of state universities and land grant institutions (75%) (U.S. House of Representatives, 1971, p. 27). In fact, the state universities and land grant institutions were utilized as the primary conduit of transfer technology to local businesses, governments, and communities. When President Lyndon B. Johnson signed the State Technical Services Act he said, "The vehicles for success will be the 250 colleges and technical schools throughout the land," and J. Kincaid,

Assistant Secretary of Science and Technology for the Department of Commerce noted the ". . . most important achievement of the State Technical Services program was the teamwork between the state and federal government and the mobilization efforts of the universities" (U.S. House of Representatives, 1968, p. 4-5). Evidence of the success of the State Technical Services Act of 1965 was striking not only in the quality of the program, but in its industrial and geographical breadth as well (U.S. House of Representatives, 1968). The State Technical Services (STS) program provided an economic development framework for higher education, business, government, and community interaction.

In addition, some review panel recommendations of the STS program in 1971 have been advocated in more recent studies of state initiatives in economic development: increased economic development initiatives aimed at cities (Malecki, 1987; Sheppard, 1986), less emphasis on referral services and more emphasis on technical field service to small- and medium-sized firms (Doyle & Brisson, 1985; Golob, 1988; Hull, 1985; Matthews & Norgaard, 1984), increased emphasis on regional cooperation (AASCU, 1986a; Beyers et al., 1987; Clark, 1982; OTA, 1984a, 1984b; Osborne, 1987), and the importance of a comparative data base to evaluate results of university/industry innovation interaction, in particular (Peters & Fusfeld, 1983; Tornatzky, 1983), and of

state/regional higher education economic development objectives, in general (Beachler, 1985; Bernstein, 1986; Beyers et al., 1987; Botkin et al., 1982; Byron, 1984; Miller & Clark, 1983; Stankiewicz, 1986).

The political demise of the STS program in 1971 left America's national economic development strategy adrift during the 1970s. While individual state economic development initiatives began to evolve around 1973, the basic problem facing America's economic growth remained a coherent economic development strategy that clearly defined factors and forces on which all parties could agree (Bernstein, 1986).

A recent study by Jones and Vedlitz (1988), Higher Education Policies and Economic Growth in the American States, reported on the crucial role higher education played in the change from a manufacturing-based to an information-based economy through creation of new businesses, noted that lack of empirical data was a problem in measuring the effect of state spending on the relationship of higher education to economic growth, and concluded:

> The direct incubation effect [on growth of new business development] may be a function of the instructional mission of universities rather than the research mission--the education of individuals capable of establishing new forums in changing economies. (p. 86)

The American Association of State Colleges and Universities (AASCU) member survey noted that some institutions developed a full range of objectives while

others focused on one or two depending upon interest and capacity and described emerging new university objectives in economic development:

1. Human resource development--tailoring education programs to meet the emerging human resource requirements of the new economy.

2. Economic and policy analysis and research--providing objective information and new knowledge to public and private decision makers about an area's economy.

3. Capacity building for economic development--assisting a wide variety of community organizations in developing the capacity to participate more effectively in economic development.

4. Technical assistance to apply existing knowledge to industry--helping firms learn about and adopt effective management and engineering concepts.

5. Research to develop new knowledge--conducting basic and applied work to produce new knowledge that can result in new products and services or improved forms of production.

6. Technology transfer of new developed knowledge to industry--purposefully helping firms to take advantage of state-of-the-art technology developed within the university.

7. Support for the development of new knowledge-based businesses--having the university take a direct role in promoting new enterprises that utilize knowledge developed within the university. (1986a, p. 10).

The AASCU study concluded, ". . . colleges and universities that are proactive and strategic in developing new roles consistent with the purposes of higher education can strengthen their position in and relevance to society" (1986a, p. viii). Increasingly, higher education resources continue to become a vital part of successful state economic

development strategies (Clarke, 1986; John, 1987; Osborne, 1987).

A rapidly changing global economy demanded a comprehensive range of state economic development initiatives that utilized the full potential of state universities and land grant institutions. A review of state university and land grant institutions' practical involvement in state and regional economic development, and the success of the cooperative agricultural extension movement and implications for similar state initiatives in cooperative industrial extension efforts recommended further investigation into the current involvement of state universities and land grant institutions in the area of economic development.

A review of the literature identified survey items that were intended to have content validity, and a controlled evaluation of those items by a panel of experts provided content validity. A panel of experts was chosen on the basis of their expertise in the area of economic development and a geographical spread that sought to avoid parochialism. Subsequent evaluations by a panel of judges provided face validity and technical quality of the instrument. The panel of judges was selected on the basis of economic development positions in academia and state/local economic development agencies. Responses of the sample population defined the dimensions (factors) of current involvement in economic

development which resulted in the validation of a survey instrument to ascertain current involvement of state universities and land grant institutions in economic development.

Statement of the Problem

The primary purpose of this study was to develop a survey instrument for measuring responses from research administrators at state universities and land grant institutions currently involved in economic development. That instrument was arbitrarily named Higher Education Economic Development Survey (HEEDS). Although the instrument was composed of two activity scales (a) Presently Occurring Activities, and (b) Should Be Occurring Activities, this study focused only on the Presently Occurring Activity Scale responses as perceived by research administrators at state universities and land grant institutions in 50 states, Puerto Rico, Washington, D.C., and the Virgin Islands. The second purpose of the study was to validate the instrument (HEEDS) through (a) a focused review of related literature, (b) a controlled evaluation of judgments from a panel of judges and a panel of experts, and (c) a statistical analysis applying procedures of factor analysis to responses collected from a sample of research administrators in higher education. More specifically, the purposes of this study were to investigate the following questions:

1. What are the general dimensions (factors) of the instrument as reflected in data collected from the sample of research administrators?

2. What is the reliability of the instrument?

3. What evidence may be presented for the instrument to establish its content validity?

4. Do the underlying factor dimensions of the instrument reflect the theoretical dimensions underlying its construction?

Significance of the Problem

In light of rapid technological growth and global economic expansion, numerous books, articles, reports, commissions, and symposia have advocated a comprehensive analysis and evaluation of higher education involvement in current state economic development growth areas (AASCU, 1986a, 1986b, Bernstein, 1986; Chmura, 1987; Clarke, 1986; John, 1987; NAB, 1984). The American Association of State Colleges and Universities (AASCU) has taken an active leadership role in identifying and promoting higher education economic development activities (AASCU, 1986a; Chmura, 1987; Logan, 1984). According to staff, NASULGC existed primarily to inform members of impending national legislation that may affect their institutions without addressing issues of policy formulation based on such information (F. Klaussen, personal communication, May 9, 1988). Moreover, a review of the literature revealed

limited empirical studies on the specific activities proposed in this study (Bernstein, 1986). Consequently, no instrument was found which was applied to the dimensions measured with HEEDS.

It was felt that validation of the five dimensions in this instrument could assist higher education in four ways: (a) establishing economic development objectives, (b) providing information to economic development centers and institutes for establishing policy guidelines, (c) providing state legislators insight into economic development activities in order to avoid duplication and promote integration of existing programs, and (d) providing a basis for further research in the area of higher education economic development.

Definition of Terms

Terms relevant to this study are defined as follows:

Applied Research: Research that is directed toward gaining "knowledge or understanding necessary for determining the means by which a recognized and specific need may be met. In industry, applied research involves discovering new scientific knowledge having specific commercial objectives with respect to products or processes" (National Science Board, 1985, p. 221).

Basic Research: Research that has as its objective "a fuller knowledge or understanding of the subject under study, rather than a practical application. Basic research

advances scientific knowledge not having specific commercial objectives, although such investigations may be in fields of present or potential interest to the reporting company" (National Science Board, 1985, p. 221).

Capacity Building (also referred to as capacity-creating aspect of investment): An effect of investment spending on the productive capacity (ability to produce goods and services) of an economy (McConnell, 1987). An efficient and effective supply and coordination of human resources and infrastructure in the development of markets and the involvement of entrepreneurs are essential steps in capacity building for economic development (Osborne, 1987).

Development: The "systematic use of knowledge or understanding gained from research, directed toward the production of useful materials, devices, systems or methods, including design and development of prototypes and processes" (National Science Board, 1985, p. 221).

Economic Development: The process through which an economy achieves long-run economic growth; involves capital formation, development of markets, growth in productivity, and improvement of entrepreneurial ability and labor skills (Ekelund & Tollison, 1988).

Human Resource Development: The tailoring of continual education to meet the human resource requirements of a global economy in a state of rapid technological change (Chmura, 1987).

Infrastructure (also referred to as capital infrastructure): Composed of seven critical elements for economic development: (a) transportation, (b) finance and legal institutions, (c) energy, (d) communications, (e) capital goods and equipment, (f) research and development, and (g) human resources (Beachler, 1985).

Macroeconomic Intervention: The broad manipulation of federal fiscal monetary, trade, and exchange rate policies that usually include manipulation of taxes, expenditures, money supply, or interest rates (Choate & Linger, 1986; Osborne, 1987).

Microeconomic Intervention: Includes federal, state, and local policies and programs in areas such as education and training, regulation, natural resources, strategic materials, government credit, research and development, infrastructure, and public health (Choate & Linger, 1986).

Research: Basic and applied work to produce new knowledge that can result in new products and services or improved forms of production (Chmura, 1987).

Technical Assistance: The application of existing knowledge that enables the recipient to learn about and adopt effective management and engineering concepts (Chmura, 1987).

Technology: A body of scientific, technical, and managerial knowledge developed by an individual or group to introduce new products and processes.

Technology Development: Technology Development includes three distinct steps: (a) Invention - the act of conception that requires a knowledge of available technological resources and an understanding of society's wants and needs; (b) innovation - the introduction of new ideas, processes, or inventions into the economy of society that requires investment of money or resources, and services of entrepreneurs, and usually involves substantial risk; and (c) diffusion - an educational/informational transfer process spreading new technology throughout the whole industry or to other industries and disciplines (U.S. House of Representatives, 1971).

Technology Transfer: The process by which new technologies are diffused and adopted throughout the economy (John, 1987).

Assumptions

Four assumptions were made related to the design and data collection of this study:

1. Content validity of an instrument may be supported through systematic development of items guided by a review of the literature.

2. Validity of an instrument may be supported through a controlled evaluation by a panel.

3. This instrument was useful for measuring perceptual roles of research administrators in higher education.

4. Factor analysis was assumed to be appropriately applied to a matrix of inter-item correlations based on an item rating scale.

Limitations of the Study

1. This study was limited to research administrator responses to validated economic development stimuli organized under five categories of Presently Occurring Activities.

2. Content validity procedures were limited to linkages between the literature and the instrument items.

3. Establishment of general appropriateness of the instrument for measuring economic dimensions was limited to a review by a panel of experts and an evaluation form.

4. The review of the literature was limited to (a) historical overview of state universities and land grant institutions and their role in economic development, (b) emerging roles of higher education in state economic development strategies, and (c) measurement theory.

Research Methodology

The design of this study comprised seven steps: (a) survey of the literature, (b) development of an instrument, (c) administration of the item-objective congruence form to a panel of experts and analysis of responses for content validation, (d) administration of the instrument for the purpose of a technical review to a panel

of judges, (e) statistical analyses of administrator responses, (f) presentation of findings, and (g) conclusions and recommendations.

Step I. Survey of the Literature

The function of the literature review was development and subsequent validation of a survey instrument. The literature review provided a frame of reference for identification of theoretical dimensions involving the role of higher education in economic development and served as a preliminary step for development of survey items for each dimension. A review of the literature was conducted with emphasis on primary sources and included the following:

1. Professional journals of science, business, engineering, higher education, and industry.

2. Symposium, Institute, Conference, Task Force, and Special Committee reports, summaries, and proceedings.

3. U.S. Congressional hearings.

4. Data banks, including DIALOG, ERIC, National Technical Information Services (NTIS), Public Affairs Information Service (PAIS), and the Dissertation Abstracts International.

5. Current books.

6. Telephone discussions with individuals knowledgeable in the area of economic development.

Step II. Development of an Instrument

The survey instrument scale format, i.e., Presently Occurring and Should Be Occurring, was adapted from a study by Kingry (1984). The "don't know" used on the survey instrument Presently Occurring Scale as a response alternative was purposefully intended to screen out respondents who do not have any knowledge of an activity and thus increase the accuracy of other responses (Schuman & Presser cited in Kidder & Judd, 1986, p. 252).

After an extensive review of the literature relating to economic development and higher education, HEEDS was developed to measure responses from research administrators at state universities and land grant institutions to current economic development involvement. Since limited instruments existed in the literature that could be applied to the population in this study, a process for content validity, face validity, and technical quality included controlled evaluation of judgments from a panel of experts and a panel of judges before the population was surveyed.

Step III. Administration of the Item-Objective Congruence Form to a Panel of Experts and Analysis of Responses for Content Validation

During the winter of 1989, the literature review (Chapter Two) and the item-objective congruence evaluation form containing a set of 57 questionnaire items were mailed

to a panel of three experts knowledgeable in the area of economic development and higher education. These three experts were chosen on the basis of their expertise in the area of economic development, their position in higher education (e.g., President of the New England Board of Higher Education; professor and Chancellor of the University of California System; and professor, co-founder, and director of a Pennsylvania economic development organization), and their role in consulting, conceptualizing, and implementing economic development programs across the United States. The panel was asked to determine content validity of the 57 items generated from the review of the literature to measure current higher education economic development involvement based on the index of item-objective congruence developed by Rovinelli and Hambleton (Hambleton, 1980, p. 88-89). The form, composed of 57 items generated from the literature review of higher education economic development, contained a three point rating scale to determine empirically the content validity of each item: not for elimination from the item pool but, if possible, for correction (Rovinelli & Hambleton cited in Hambleton, 1980, p. 88). According to Henerson, Morris, and Fitz-Gibbon there is evidence of consistency if different people report pretty much the same thing (1987, p. 149). Therefore, the panel provided a basis for inter-rater reliability.

In addition to the evaluation form, the panel was asked to comment on the following aspects of the study: economic development issues omitted and suggestions or comments that you feel would make this study more usable and valuable for professional economic developers. Thus, their responses were used in a controlled evaluation process in refining and revising the instrument for the survey of the population as well as for the purpose of obtaining content validation of the items used in the instrument and generated from the literature review.

Step IV. Administration of the Instrument to a Panel of Judges for the Purpose of a Technical Review

In April, 1989, a preliminary instrument was mailed to a panel of judges selected on the basis of economic development positions in academia and state or local economic development agencies. These judges were asked to review the instrument and respond either yes or no to the following question regarding the technical quality of each item: Is the item clearly written and appropriate to the response scale? In addition, the judges were asked to respond with reactions, comments, or suggestions to the following aspects of the instrument: 1) Are there economic development issues not included which should have been in a survey of administrators in higher education? 2) Are there suggestions for improvement of the instrument's directions?

and 3) Are there other suggestions or comments for improving the Higher Education Economic Development Survey (HEEDS)?

Both the item-objective congruence evaluation undertaken by a panel of experts and the technical review of the instrument by a panel of judges constituted an a posteriori approach to item validation. This approach assessed whether or not a direct relationship between each item and the theoretical construct existed by an analysis of data collected after the items were written (Hambleton, 1980, p. 87).

Step V. Administration of the Instrument to the Population of Research Administrators

The population consisted of 318 research administrators who served on the Council of Research Policy and Graduate Education and the Society of Research Administrators in all 50 states. In addition, the population consisted of 83 cooperative extension administrators and directors from 50 states, Puerto Rico, Washington, D.C., and the Virgin Islands. Nineteen surveys also were sent to research administrators in higher education for a combined total population of 420. A factor analysis determined the dimensions of responses to the instrument by research administrators in higher education.

Step VI. Statistical Analyses of Administrator Responses

Factor analysis was chosen as the data reduction statistical procedure in order to identify the theoretical dimensions of the instrument underlying its construction.

Step VII. Presentation of Findings

Results of pertinent aspects of this study were illustrated in the following tables: (a) Table 1 presented the results of the item response and item acceptability of a panel of three experts for 57 items of HEEDS; (b) Table 2 reflected levels of endorsements of eight judges from which the interjudge reliability for the 56 item of HEEDS was computed; (c) Table 3 presented a summary of survey returns; (d) Table 4 presented survey response rates; (e) Table 5 contained demographic frequencies and percentages; (f) Table 6 presented eigenvalues and percentages of variance for the five major factors; (g) Table 7 presented correlations among the five factors; (h) Table 8 contained a table of factor loadings; (i) Tables 9-13 presented items for each of the five factors, and (j) Tables 14-18 contained MANOVAS of factor scores with selected main effects.

Step VIII. Conclusions and Recommendations for Further Studies

HEEDS measured responses to current economic development involvement and differentiated between economic

development activities that are Presently Occurring and Should Be Occurring as perceived by research administrators in higher education. The conclusions reported in this study are based solely on responses to the Presently Occurring Activity portion of the instrument. Four research questions provided a framework for interpreting the resulting data:

1. What are the general dimensions (factors) of the instrument as reflected in data collected from the sample of research administrators?

2. What is the reliability of the instrument?

3. What evidence may be presented for the instrument to establish its content validity?

4. Do the underlying factor dimensions of the instrument reflect the theoretical dimensions underlying its construction?

In addition, validation of HEEDS provided data which may contribute to further research on the role of higher education in economic development, particularly state universities and land grant institutions.

Organization of the Study

This study was presented in five chapters. Chapter I contained an orientation to the problem, a statement of the problem, the significance of the problem, definition of terms, assumptions and limitations of this study, and the research methodology.

Chapter II presented the review of the literature to provide a frame of reference for developing questionnaire items to be validated in a survey of research administrators at state universities and land grant institutions and included: (a) an historical overview of state universities and land grant institutions and their role in economic development, (b) emerging roles of higher education in state economic development strategies, and (c) an analysis of measurement theory regarding development of the survey instrument.

Chapter III contained a detailed presentation of the methodology and procedures used, including the development of the instrument and subsequent steps for validation and realibility. It also provided a description of the population and method of data collection.

Chapter IV consisted of an analysis and presentation of the results of the validity and reliability of the instrument by a panel of experts and a panel of judges; the second section contained the results of a factor analysis of research administrator responses and the underlying factor dimensions of the instrument.

Chapter V contained the summary, conclusions, and recommendations.

II. REVIEW OF THE LITERATURE

Economic development has become an important issue in higher education. A historical overview of the role state universities and land grant institutions have played in economic development provided an insight into their current involvement with business, government, and community initiatives that promoted regional/state economic goals and objectives.

One tool which may be used to identify current involvement of these institutions in economic development is a survey instrument. In designing an instrument to validate the dimensions (factors) of institutional involvement, the review of the literature covered three major areas: (a) historical overview of state universities and land grant institutions and their role in economic development; (b) emerging roles of higher education in state economic development strategies; and (c) measurement theory.

Historical Overview of the Growth and Development of State Universities and Land Grant Institutions

Higher education in colonial America was predominantly private in nature, exclusive by choice, and solely dedicated to educating the clergy and intellectual elite. The

classical curriculum fit colonial America's higher education mission and served the needs of its constituency. Though advocated by Benjamin Franklin and all of the first six presidents of the United States, early attempts to legislate a national university failed due to political and financial difficulties (Brubacher & Rudy, 1958, p. 217). The European Age of Enlightenment, however, provided philosophical grist for the American Revolution, transformed thinking on education, and raised new questions about what the institutional setting of American higher education should be. Hofstadter and Smith (1961) raised the following questions:

> Should education be left in the hands of the sects? Should the states, which had already begun to enlarge their roles as sponsors of education in an age of revolt against established churches, make themselves the primary or sole agents promoting colleges? Should the new federal union create its own university as a standard-setter and cultural center? If many competing agencies were at work in the educational field, would they not hamstring each other and create a collegiate chaos? How were the small and rather limited colleges of the colonial period to be enlarged into true universities, centers of general advanced study? (p. 147)

While few doubted the importance of education to the new society emerging in colonial America, Brubacher and Rudy (1958) noted that democratic resistance to central authority among the general populace weakened the argument for a national university, but encouraged the "states-rights philosophy" (p. 218). Thus, colonial America's initial urge for education grew out of a strong emphasis on individual

self-reliance (prompted by the Enlightenment inspired fear of sectarian control of education) and an admitted belief that sending "American youth abroad for their education would be a humiliating acknowledgement of ignorance or inferiority" (Hofstadter & Smith, 1961, p. 147). The result of this combination of factors was the impetus for the founding of the first state university in Georgia in 1785, soon followed by the University of North Carolina in 1789, the University of Tennessee in 1794, the University of South Carolina in 1801, the University of Michigan in 1817 (twenty years before Michigan became a state), and the University of Virginia in 1825 (Hofstadter & Smith, 1961, pp. 148, 175).

Moos (1981) acknowledged in The Post-Land Grant University that the concept of the state university movement in 1785 was developed to "support the infant republic, help citizens, and promote economic development as well as train minds and improve manners" (p. 2). Moos further reflected that after the passage of the Morrill Act of 1862 establishing land grant institutions, state universities and land grand institutions reinforced the practical emphasis of American higher education (1981, p. 3). The transformation of American higher education was gradual, however, and even Thomas Jefferson's early efforts to reform the curricula and to emphasize practical education that would promote economic development were unsuccessful until increased public pressure and a growing scientific age prompted higher

education to remodel the classical patterns of American colleges (Eddy, 1957, p. 7).

In the Public Trust, a 1987 report by the National Association of State Universities and Land Grant Colleges [NASULGC] to the U.S. Congress on the status of land grant institutions after 125 years, reflected upon the significance of the 1862 and 1890 Morrill Acts:

> Farsighted legislation enacted by Congress and signed into law by President Lincoln during the Civil War granted federal land to every state which would agree to establish at least one college to teach agriculture and the mechanic arts, along with other scientific and classical subjects. The goal of the land grant measure was "to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life." The 1890 Morrill Act expanded the 1862 system of land grant institutions to include historically black institutions . . . [since then] 72 colleges and universities in the 50 states, the District of Columbia, Puerto Rico, Guam, and the Virgin Islands are committed to the land grant philosophy of teaching, research, and public service. The land grant movement is a uniquely American philosophy toward higher education that embraces the concepts that 1) campuses should be accessible to students from all economic classes, 2) higher education should be practical, as well as classical, and 3) colleges and universities should draw support from the federal government. (pp. 4-5)

Eddy (1957) credited a severe crop failure in 1836 which prompted the beginning of the American agricultural movement and made a more efficient farmer a pressing national issue. Older, classical institutions played catch-up with the agrarian/research-oriented movement and Eddy (1957) chronicled the most notable:

> 1846--Yale established two new professorships: [one in] agricultural chemistry and animal and vegetable physiology, and the other in practical chemistry.

> 1847--Abbot Lawrence left a sizable fortune to Harvard for the Lawrence Scientific School.
> 1859--James B. Sheffield began the Sheffield School of Science at Yale.
> By 1862, perhaps 20 institutions could be classified as scientific, although science was taught for its own sake, i.e., like literature, science was to be studied but not used. (p. 11)

While the state universities had a significant impact on American higher education philosophy, it remained the task of the land grant movement and the evolution of the utility principle all working together to construct a public higher education system unparalleled in world history.

Hofstadter and Smith (1961) noted that the state universities did not reach their potential until after the Civil War and the advent of the land grant movement (p. 149). Actually, a number of social-cultural phenomena arose during this era that reflected the temper of the times and ultimately influenced higher education including the popularism espoused during President Andrew Jackson's administration, the growth of the state universities and inception of the land grant movement, the increasing advocacy of the Utility Movement in higher education that although not occurring until after 1865 appeared to echo the Jeffersonian theme of practicality and usefulness, and the increasing inability of the religious sects to cooperate regarding the orderly growth and development of educational organization (Eddy, 1957; Hofstadter & Smith, 1961; Veysey, 1965). In fact, Veysey (1965) paralleled the rise of the state university with the advocacy of the Utility Movement

reformers in higher education that did not occur until after 1865 and explained the connection as the result of influence the reform leaders exerted on the growth of higher education after their academic appointments to Harvard and Cornell gave them "respectability" (p. 60).

Veysey further differentiated between the term utility used during the period 1865-1875 to describe higher education reform that espoused practicality, usefulness, or service and John Stuart Mill's Utilitarian Philosophy that the goal of civilized society should be the greatest good for the greatest number of people (1965, p. 60). Actually, two versions of utility were espoused from 1865-1876 in American higher education according to Veysey: one at Cornell inculcated the goals of practical education from its inception and became a pervasive influence on its subsequent academic direction, while Harvard under President Eliot, adopted a more gradual approach that did not reach fruition until the 1880s (1965, p. 98). In fact, the principles of utility promulgated during this era found their truest expression in the words of David Starr Jordan, President of Stanford University:

> The entire university movement is toward reality and practicality. No separation should exist between the scholar and the man; knowledge should be judged by its ability to harmonize the forces of life. (Veysey, 1965, p. 61)

Over a period of time, advocates of utility in higher education, faced with increasing competition from other

types of academic reformers, sought to promote their cause from within as administrators and faculty and thus assured them of an adequate hearing (Veysey, 1965, p. 61).

Allan Nevins in The State Universities and Democracy pointed out "the orientation of some universities to their states or community colleges to their counties is an American invention" (Nevins cited in Moos, 1981, p. 8). This uniquely American relationship between community/state and higher education was the precursor of the education extension movement. Although the education cooperative extension movement culminating in the Smith-Lever Act of 1914 traced its origins to the pre-Civil War Lyceum movement (1832) and the post-Civil War Chautauqua system (1874), it was not until Ohio State University set up a successful noncredit, nonexamination course in the winter of 1878-79 for all interested farmers that the extension movement truly began in American higher education (Eddy, 1957, p. 79). Bringing predominantly agricultural instruction from the campus into the villages and small towns was a remarkable American precedent that was eventually extended through the Wisconsin Idea. In 1909, Lincoln Steffens' newspaper article "Sending a State to College" remarked "The University of Wisconsin at Madison offered to teach anybody--anything--anywhere":

> The university was pictured as a kind of living reference library for the state as a whole. Steffens' article revitalized the utility notion to a pitch forgotten since the earliest years at Cornell

> . . . [and when] University of Wisconsin president, Charles Van Hise, rejuvenated the university extension fad of the early 1890s by extending its scope to professorial involvement in state government, the Wisconsin Idea became a permanent fixture in American higher education extension. (Steffens cited in Veysey, 1965, p. 108)

Thus, the Wisconsin Idea, in addition to reviving the concept of utility in higher education, introduced two important elements in the higher education-economic development connection: the entry of the expert into government, and second, the extension movement. Although the Progressive Era began in the 1890s and extended into the 1920s, nowhere did it reach the level of a "close partnership between state government and the state university" as it did in Wisconsin (Brubacher & Rudy, 1958, p. 164).

It was not until the mid 1800s that the first research universities in America emerged from three primary sources: (a) the German university model, (b) the land grant institutions, and (c) the technical/engineering-oriented schools (Government, University, Industry Roundtable [GUIR], 1986, p. 3). Although Yale University granted the first American Ph.D. in 1861, Eddy (1957) acknowledged the real development of the research tradition in American higher education between 1863-1879 when:

> a tremendous spurt [occurred] in the development of scientific teaching and experimentation . . . the University of Maryland as early as 1858 tried various agriculture experiments and Pennsylvania State in 1864 included investigation as one of the prime essentials in an ideal university. (p. 76)

State universities and land grant institutions had a special relationship with the people, industries, and governments of their region; however, it was not until after the passage of the Smith-Lever Act of 1914 providing for cooperative extension services "that much of the latest research of the state campuses was carried out to working farmers and homemakers, as it is to this day" (Moos, 1981, p. 9). In fact, Peters and Fusfeld observed that the most notable example of university-industry research interaction after World War I resulted in the 1930s General Electric-Harvard partnership which garnered a Noble Prize for Physics (1983, p. 25). The GUIR publication New Alliances in Partnerships in American Science and Engineering (1986) indicated that during the 1920s and 1930s "private foundations were the dominant source of university research funding" (p. 6); and prior to World War II, "Trade Associations were the main way of fostering university research" (Peters & Fusfeld, 1983, p. 95). Industry commitment to basic research was at its height during the 1950s and 1960s; after World War II, the federal government became the dominant source of university research funding (Peters & Fusfeld, 1983).

While the university-industry research interaction varied with the traditions of the individual university, the specific science discipline involved, and the industry, these interactions also were influenced by the sources of university funding, and the prevailing attitudes about the

appropriate roles of universities, businesses, and government (Peters & Fusfeld, 1983). For instance, Peters and Fusfeld (1983) reported that "out of 2,000 colleges and universities and 14M businesses the bulk of R&D is conducted within 20 universities and 20 corporations" (p. 25); or stated another way "most universities (80%) receive less than 10% of the total university R&D expenditures from industry" (p. 116). Out of the top institutions of higher education funded by industry, however, "49% are state universities and land grant institutions" (Peters & Fusfeld, 1983, p. 116).

In the past, particularly in the South and parts of the Midwest and Northeast, social factors, i.e., the perception of state universities as cultural centers and land grant institutions' emphasis on practical instruction, influenced where established families sent their children. However, the differences between the two kinds of institutions increasingly have become "ones of style and tone rather than substance" (Moos, 1981, p. 11). The evolution and merging of the state universities' and land grant institutions' unique philosophy of higher education was reflected in their mutual working and research relationships with industries in their region as well as their bonds with community and state government agencies "aiding budget or planning officials with the latest techniques, training [local community] officials in public administration, and serving as the

research arm of state agencies of transportation, environmental affairs, or economic development" (Moos, 1981, p. 9).

Considering the role of state universities and land grant institutions in government, community, and industry interactions and the current levels of research funding at these institutions, it is apparent that a framework existed that made the state university and land grant institution the appropriate model for incorporation and delivery of national and regional economic development objectives. As a result of the success of the agricultural cooperative extension program through the Smith-Lever Act of 1914, increased farm productivity reduced the need for farm labor and provided additional manpower to fuel the nation's subsequent industrial growth and the growing number of engineering/technical schools (Eddy, 1957; U.S. Senate, 1965). Furthermore, the success of agricultural extension during the early part of this century provided a framework for future industrial extension efforts (U.S. Senate, 1965) and the increasing reliance of individual states on their state universities and land grant institutions paved the way for future university-industry-government-community interaction (Moos, 1981; Osborne, 1987). The interdependency of these elements played a major role in the passage of the State Technical Services Act of 1965. In testimony before the U.S. Senate, Thomas Marshall Hahn,

President of Virginia Polytechnic Institute and now CEO of Georgia-Pacific Corporation, spoke emphatically on behalf of the National Association of State Universities and Land Grant Colleges:

> **Mr. Hahn.** It would seem to me that we are discussing here an area of vital national interest, and the areas of information required which will of course differ from region to region across the Nation. . . . a century ago we had almost three-fourths of our labor force on the farm producing our food and fiber needs. And today we have less than one-tenth of our labor force producing our food and fiber needs. . . .
>
> As a matter of fact, this is the principal ingredient in the success of our industrial economy because we can release most of our labor force for the manufacture of automobiles, television sets, Gemini space vehicles, and all of the other ingredients for our high standards of living.
>
> **Senator Lausche.** And it is your belief that the supply of information to the farmer enabling him to improve the productivity of the land can in principle be applied to industry and business, and that therefore this program is sound?
>
> **Mr. Hahn.** Emphatically, yes. (U.S. Senate, 1965, pp. 102-103)

Though short-lived, the State Technical Services Act of 1965 (PL 89-182) was far-sighted legislation with a declared purpose that promoted

> wider diffusion and more effective application of science and technology in industry . . . essential to the growth of the economy, to higher levels of employment and to the competitive position of United States products in world markets. . . . that the benefits of federally financed research, as well as other research, must be placed more effectively in the hands of American business and enterprise. . . . that the several States through cooperation with universities, communities, and industries can contribute significantly to these purposes by providing technical services designed to encourage a more effective application of science and technology to both new and established industries. . . . the purpose of this Act is to provide a national program of incentives and support for the several States individually and in

> cooperation with each other in their establishing and maintaining State and regional technical service programs designed to achieve these ends. (U.S. House of Representatives, 1965, p. 2)

In the initial hearings of PL 89-182, Congressman J. Mackay (D-GA) registered concern over the connotation of the term "technical" that might have restricted the program from aiding businesses in ethical conduct, marketing, labor relations, computer applications to management decision making, and in addition, encouraged multidisciplinary cooperation within the university system:

> Practically every business process today is technical in nature, whether it be accounting, finance, management, marketing, or even labor relations. The application of scientific methods, procedures, and equipment to the solution of business problems and to aid in the development of the economic process is a matter of fact, now. . . . For example, a new mechanized technique in accounting provided to an industry or business is truly a "technical service." The application of computers to management decision making is a "technical service." The application of new knowledge reached through research in the behavioral sciences is a "technical service." Even the development of ethical conduct in business situations could be a "technical service." Yet the working of the proposed act before you does not offer strong evidence that these areas should be construed as technical services. (U.S. House of Representatives, 1965, p. 85)

Evidence of the success of the State Technical Services Act of 1965 was striking not only in the quality of the program, but also in its industrial and geographical breadth (U.S. House of Representatives, 1968). In addition, the State Technical Services (STS) program review reported increased economic development need for services among cities; less success with referral services to small- and

medium-sized firms where more one-on-one technical assistance was required; success with regional and interstate cooperation; and the importance of a comparative data base to evaluate results. In 1971, amendments (H.R. 6976) to PL 89-182 proposed five significant changes: "The offering of services to municipalities, emphasis on technical field service agents rather than literature supplements, incentives for cooperative interstate programs, increased authorizations, and establishment of management information systems to coordinate and evaluate program results" (U.S. House of Representatives, 1971, p. 10).

State governors predominately designated state universities and land grant institutions as STS program coordinating agencies between resource-information centers and end-users (U.S. House of Representatives, 1971, pp. 74-75). Not only were the agencies designated by the states to implement and coordinate the State Technical Services Act of 1965 predominantly colleges and universities (74%), but the largest segment of this group was comprised of state universities and land grant institutions (75%) (U.S. House of Representatives, 1971, p. 27). In fact, the state universities and land grant institutions were utilized as the primary conduit to transfer technology to small businesses, governments, and communities. J. Kincaid, Assistant Secretary of Science and Technology for the Department of Commerce noted "the most important achievement

of the State Technical Services program was the teamwork between the state and federal government and the mobilization efforts of the universities" (U.S. House of Representatives, 1968, p. 5).

Favorable evaluations of the State Technical Services program by the Elliott Committee and Arthur D. Little, Inc. foreshadowed current economic development initiatives:

> STS encouraged regional programs because the economic problems which states face are regional in character or are common to several states (Chmura, 1987; Hansen, 1988; Osborne, 1987).
>
> STS transfer of knowledge occurred best through personal contacts by field service agents familiar with the problems of business (Osborne, 1987).
>
> STS had been most helpful to small- and medium-sized firms which did not have broad technical and research capabilities (Doyle & Brisson, 1985; Peters & Fusfeld, 1983).
>
> STS program provided useful technical services to firms who could not pay for such services (Peters & Fusfeld, 1983).
>
> STS field service agents were the most valuable part of the program (Osborne, 1987).
>
> STS technology transfer was seen as new and valuable to the user although it may have existed elsewhere for some time (Sahal, 1981).
>
> Successful STS program personnel were aggressive risk-takers who were willing to make informed judgments on technical and business issues, and to commit resources in situations where a successful outcome could not be predicted (AASCU, 1986a; Peters & Fusfeld, 1983).
>
> A few successful cases produced most of the benefits while the majority of cases produced little or no benefit which is typical of activities involving innovations (Sahal, 1981; Shrum, 1985).

The findings of the Elliott Committee emphasized the success of the State Technical Services Act of 1965 intention to utilize the nation's colleges and universities to satisfy the technical needs of the business community, and leveraged user fees or transfer of internal funds to secure matching funds (U.S. House of Representatives, 1971, p. 190). Moreover, the Elliott Committee observed that "states having a field service program, backed up with reasonable information resources, were enjoying excellent success. The personal contact was benefiting the user and providing direction for the participating institutions in their future endeavors" (U.S. House of Representatives, 1971, p. 190). Within three years every state but Mississippi had an active technology transfer program (Appendix B). Despite an enthusiastic reception by the states, favorable reports from the Elliott Policy Review Committee and favorable reviews by Arthur D. Little, Inc., the STS program was dropped (U.S. House of Representatives, 1971). A recent article by Schmandt and Wilson in Economic Development Quarterly, "State Science and Technology Policies: An Assessment," reviewed eight state government programs designed to promote economic development through support of research and technological innovation since the 1960s noted distinct differences in the early STS program compared with more recent state initiatives:

> The initiatives differ significantly in respect to both goals and institutional intergovernmental dynamics. In

> the 1960s, a principal goal was to solve pressing social problems. Though the State Technical Service Act of 1965 had a technology transfer dimension to it, for the most part, states did not seriously pursue economic development through science and technology policies. In the 1980s, however, the focus of state policy has been almost exclusively on economic development; social problems, environmental problems, and infrastructure supply problems have not been concerns of recent state science and technology policy. The second salient difference involves the institutional context. The efforts of states in the 1960s were largely responses to federal initiatives. As we have seen in the 1980s, the initiative has rested entirely with state governments. This observation is consistent with renewed state activism in other policy realms. (Schmandt & Wilson, 1988, p. 13)

The success of cooperative extension, agricultural, and technological achievements, combined with an institutional mission that focused on public service and research, established a precedent for state university and land grant institution involvement in economic development. This precedent became a framework for the State Technical Services Act of 1965 and illustrated efficient and effective economic development cooperation among all constituencies at the federal, state, and local levels of government (Moos, 1981):

> To locate the objectives of a major public research university in the post-land-grant era one can no longer look at the state university in isolation. The state university must be seen as one special part of a network of state colleges and community colleges, all of which collectively carry out the enlarged land-grant mission. In the post-land-grant era the emphases and connections of the public research university are the main components of its mission. (p. 11)

Emerging Roles of Higher Education in State Economic Development Strategies

Higher education has been acknowledged as a key factor in economic development (Bernstein, 1986; Botkin et al., 1982; NASULGC, 1987; Osborne, 1987; Sheppard, 1986; Stankiewicz, 1986). Beyers et al. (1987) stressed that it was "the single most important factor" in maintaining growth in the service sector and concluded

> The most important input to producer services is human capital, and education is the ingredient that differentiates the level and quality of human capital. The quality and quantity of education influences how many founders/entrepreneurs and potential founders and entrepreneurs exists within a given population. The same availability of education excellence locally influences availability of the highly trained and trainable labor force which in turn will allow a company or region to participate in this most dynamic sector of the economy's employment growth. (p. 14)

In light of increased emphasis on the importance of education in developing human capital, new economic development strategies are replacing traditional attempts to promote industrial competitiveness through low-cost labor, cheap land, and tax subsidies (Malecki, 1987; Morrison, 1986) with revitalization strategies to promote local economic development efforts that supported local entrepreneurs, assisted existing industry, and encouraged high growth sectors (Chmura, 1987; Malecki, 1987). Such an effort demanded establishment of a new kind of economic infrastructure that required the availability of such key resources as: (a) accessible technology, (b) skilled labor, (c) available risk capital, (d) entrepreneurial climate,

(e) high quality of life (Chmura, 1987, p. 15). Thus, the emerging roles of higher education in state economic development strategies were directly related because colleges and universities were major contributors to virtually all the elements of the emerging economic infrastructure described by Chmura (1987). The review of the literature not only emphasized this role, but also made recommendations to strengthen the existing bonds between academia and those it served.

Based on this review of the literature, the following procedures used by the researcher in item generation included: a review of related literature on higher education economic development activities, assimilation of that review into five theoretical dimensions, and representative items generated from each dimension to measure the perceptions of research administrators of the current involvement of their institutions in economic development. The five dimensions were Human Resource Development (HRD); Research, Analysis, and Evaluation (RAE); Capacity Building (CB); New Business Development (NBD); and Technology Development (TD). Subsequently, these 56 items have been determined by a panel of experts to be content valid and representative of the domain of higher education economic development.

Human Resource Development

Of all the seven emerging roles of higher education's involvement in economic development described in The Higher Education-Economic Development Connection, human capital broadly defined as targeted human resource development was listed as the most important and emphasized labor as a capital investment in an information-based economy (AASCU, 1986a, p. 67). Lynton and Elman in New Priorities for the University listed four adaptations academia must make in the way they collectively perceived human resource development: (a) be more flexible with respect to what constitutes scholarly activity in light of increasing pedagogical demands on faculty, (b) be more flexible with regard to format, location, and timing of instruction, (c) be more flexible in response to external demands regarding new courses/curricula, and (d) be more flexible with regard to potential faculty collaboration with industry, government, and community needs (1987, pp. 107-110).

Lynton and Elman (1987) argued for a model of a modern university that required faculty to be in active contact with the world outside academia. If colleges and universities are to engage in economic development activities such as capacity building, technical assistance, technology transfer, and human resource development, then faculty effort towards those ends must be rewarded (Crosson, 1986, p. 119). Crosson cited a 1979 Tuckman study of reward

structures in higher education that found few empirical attempts to examine the relationship between faculty activity and faculty rewards (1986, p. 120). Although public service was the backbone of economic development at the local level, Crosson found that most faculty members believed that public service activities were not rewarded; and furthermore that there were no mechanisms for measuring the amount of public service in higher education, no longitudinal studies of service activity, and no empirical studies that linked reward systems and public service (Crosson, 1986, pp. 120-121). Consequently, there was little institutional reward that promoted faculty involvement in economic development activities. In addition, she noted a 1985 Elman and Smock study for NASULGC that advocated rewarding faculty activity that: (a) created new knowledge, (b) trained others in the discipline or area of expertise, (c) aggregated and interpreted knowledge to make it understandable and useful, and (d) disseminated the knowledge to the appropriate user or audience (Crosson, 1986, p. 122). Under the present tenure and promotion system, faculty is rewarded for contributions to the research literature, "not for synthesizing that literature in forms that might be useful to others, providing policy analysis to industry, developing applications of research to practical problems, delivering technical assistance to either emerging or established industries" (Lynton cited in

Tucker and Mandel, 1987, p. 5). The emerging model of a modern university to meet societal needs must encourage faculty public service contributions that demand inclusion of the following:

> **Recognize public service contributions that promote economic development activities in an institutional reward system in addition to the traditional scholarly engagements** (Lynton & Elman, 1987, p. 102).

The Wye Plantation Conference in Eastern Shore, Maryland, identified four major human resource development trends bearing on higher education: (a) the needs of students, (b) the delivery of information, (c) the organization of knowledge, and (d) the relationship of higher education to economic development and concluded that changing demographics meant academia must adjust to continuing, lifelong education of non-traditional students (Preer, 1984). Changing demographic patterns in the traditional college cohort in American higher education indicated that "of 12 million students, only about 2 million are full time, in residence, and 18-22 years of age" (Hodgkinson, 1985, p. 10) challenged basic assumptions regarding the impact of convenient, lifelong, continuing adult education on an increasingly aging society. For example, David Packard, Chairman of the Board of Hewlett-Packard Co., noted arrangements with Stanford and the University of Colorado that enabled Hewlett-Packard employees to attend class while at work utilizing closed

circuit television with microphones so they could ask questions:

> There was a great deal of concern by the faculty as to whether this would work. . . . it turned out that our employees got better grades than the people who attended class. . . . there are a lot of modern communication techniques that can be used extensively. This means that a larger number of students can participate in the classes that the professors are already undertaking. (WHSC, 1986, p. 46)

Such a flexible response by academia with respect to consumer needs regarding format, location, and timing of instruction illustrated the fact that academia and industries do not work on the same schedule or at the same pace. In order to facilitate university-industry interaction this researcher suggested the following item in addition to one suggested by Lynton and Elman:

> **Offer appropriate instruction at flexible times to meet the unique needs of industry, community, and state/local government in planning for economic development.**
>
> **Utilize advanced telecommunication delivery systems that beam instruction from campus via satellite uplink to the consumer** (Lynton & Elman, 1987, p. 131).

Another major aspect of human resource development that went beyond traditional postsecondary education and training activities and yet proved indicative of the need for higher education to adapt to the changing demographics of an adult student population was the issue of child care (AASCU, 1986b; Osborne, 1987; Southern Growth Policies Board, 1986; Useem, 1986):

> Today, mothers of half of the children one year of age and under are at work. Most of these women need to and

> will stay at work. They and their families require good child care. Only 1,800 of our six million employers provide such assistance in any form such as employee benefits, on-site care, or financing. (Choate cited in AASCU, 1986a, p. 17)

As a result of changing American lifestyles, more children were entering school from: "single-parent households; minority backgrounds; poverty households; teen-age mothers; Asian-American backgrounds with increasing language difficulties; and Hispanic backgrounds with a 40% high school drop out rate" (Hodgkinson, 1985, p. 10).

The severity of social and economic consequences for failure to ameliorate eroding human resource losses has prompted states to examine ways to expand and improve child care (Osborne, 1987; Southern Growth Policies Board, 1986). Reich (1988) estimated 20% of American 18-year-olds are functionally illiterate, and 25% drop out of high school before graduating and he acknowledged that this was not the sort of population likely to generate high productivity in the future (pp. 526-527). Postsecondary strategies of intervention were restricted by the nature of their mission, role, and scope; however, a viable community/technical college response might include offering workfare subsidized, on-campus day care facilities to students' children, and state and local subsidies to faculty, staff, and other students who qualify. In addition, colleges of education pre-school programs could provide a source for undergraduate practice teaching, graduate internships, and research grant

opportunities to evaluate effective curricula and teaching methodologies, and to analyze early childhood learning behaviors: especially those related to disabilities and other aspects of rehabilitative special education. Thus, an innovative response to an institutional mission that fulfilled public service, teaching, and research responsibilities while addressing an urgent economic development and human resource need prompted this item:

> **Provide a pre-school program for families of faculty, staff, and students.**

A flexible response by academia to external demands regarding periodic reevaluation of new courses and curricula should be based on objective data that reflect the particular mission of the institution with respect to its role in human resource development. For example, the expansion of foreign trade in economic development has increased the role of postsecondary education in human resource development (Osborne, 1987). In particular, core instruction in international studies and promotion of foreign language requirements were cited most often as examples that effectively prepared students to cope with a global economy (AASCU, 1986a; Botkin et al., 1982; Choate & Linger, 1986; Doyle & Brisson, 1985; Levine, 1984; Moos, 1981; NEBHE, 1987). Moos (1981) made these recommendations to strengthen the core curriculum at the University of Maryland:

Promote an undergraduate foreign language requirement (p. 189).

Promote international studies as a core requirement for undergraduate curricula that enhances knowledge of other cultures (p. 104).

Conduct a junior year abroad foreign exchange program (p. 105).

In the past, it was widely assumed that upon completion of a college education it was time to move on to the real world and to apply that knowledge; however, the increasingly rapid pace of technological change has made such a view totally unacceptable (WHSC, 1986, p. 27). For example, the half-life of an engineer's knowledge is thought to be three to five years (AASCU, 1986a, p. 12) and implied the need for closer university-industry collaboration in continuing education with regard to curricula review and development. Also, the current use of pedagogic methodologies is not conducive to adequate preparation of students for coping with problems in the face of rapid technological change (Choate & Linger, 1986; Levin, 1984; Li, 1980). For example, Kerr and Pipes argued that the crises in engineering education was a result of the emphasis placed on engineering science to develop basic knowledge at the expense of engineering design which entailed devising a system or process to meet desired needs (1987, pp. 37-38). Sample (1988) contended that being considered educated in America today demanded fluency in two languages--English and calculus. He concluded the concept of whole-person

education, far from being a romantic notion was a necessity, "These times cry out for truly liberal and truly integrative education, both in the arts and sciences and in the undergraduate professional curricula" (Sample, 1988, p. 56). Furthermore, Tucker (1983), in a paper presented at the National Conference on Higher Education entitled Reflections on Retooling America for Economic Growth through Investments in Higher Education, advocated educating nor just more engineers, but rather more engineers who are creative and broadly educated enough to tackle confidently quite unfamiliar problems. Tucker noted university efforts to respond to development of new fields of knowledge often cut across the old,

> it adds interdisciplinary structures (institutes, laboratories, centers, and so on) that do not replace the old [departmental] structure, but are rather layered on above it. . . . But it is precisely in these interdisciplinary structures that students stand the best chance of working on large technical projects and on unconventional problems with a lot of colleagues in relatively flat organizational structures. (1983, p. 5)

Consequently, if American engineering education intends to continue to be a vital part of economic growth through technological advancement, then curricula changes to overcome lack of creativity and a practical sense of invention to anticipate public needs are prerequisites for the engineering graduate of tomorrow.

Li (1980) argued that while content knowledge may become obsolete, comprehension of innovation developed entrepreneurship. He described a classroom methodology that

enhanced understanding of innovation and promoted entrepreneurship, called parameter analysis. Parameter analysis imitated the innovation process, i.e., a creative endeavor involving continual selection, analysis, evaluation, and synthesis:

> Creative writing, music composition, dance, and athletics are taught in schools, even though achievement in each activity hinges heavily on individual talent. By contrast, in the conventional curriculum of engineering and management schools, very few courses emphasize developing creativity in invention and entrepreneurship. (Li, 1980, p. 23)

In addition to parameter analysis methodology advocating interdepartmental cooperation that combined case studies with problem-solving simulations (Li, 1980), other methodological strategies to promote understanding of the innovation process included: conflict strategy models (Schelling, 1960), and multiple scenarios based on conceptual simulations (Allison, 1971). In order to promote problem-solving, Li advocated multiple perspectives gained from multidisciplinary study and emphasized the importance of creativity in addition to content knowledge. His recommendations for enhancing student problem-solving included:

> **Provide policies that encourage undergraduate interdepartmental studies** (1980, p. iii).
>
> **Devise instructional methodologies across curricula that utilize case studies in combination with problem-solving simulations** (1980, p. 22).

Advocates of conceptual models of a modern university insisted on the explicit recognition of the role of

technology in science and industry and suggested the result of the separation of the two would be counter-productive for both (National Academy of Engineering Science, 1985; Stankiewicz, 1986).

Besides methodological changes in how we teach, new fields of study have emerged as a result of space exploration, advanced medical technology, and applications of computer science to other fields that have implications regarding what we teach (AASCU, 1986a; Peters & Fusfeld, 1983). For example, the application of principles in computer science and management created a new field whose purpose is to manage and apply information systems technology is emerging as one of the newest and most visible management areas (Klingman & Phillips, 1988, p. 22). In fact, the White House Science Council reported "the most exciting and fruitful research opportunities are to be found in the interface areas between the traditional disciplines" and encouraged federal funding to enhance multidisciplinary activities within the universities (1986, p. 16). Therefore, in light of the increased need for creativity encouraged by new perspectives, the researcher proposed the following item:

> **Encourage academic policy that requires multidisciplinary graduate study within the framework of traditional departments.**

In addition to collaboration with industry and government, Lynton and Elman included community

encouraged by new perspectives, the researcher proposed the following item:

> **Encourage academic policy that requires multidisciplinary graduate study within the framework of traditional departments.**

In addition to collaboration with industry and government, Lynton and Elman included community collaboration as well (1987, p. 110). Rolzinski defined community in terms of economic development that included "planning and implementing programs to improve the economic well-being of people within their social context" (1986, p. 90). As higher education institutions increase emphasis on economic development, the challenge of collaborative arrangements with business, organized labor, government, and community organizations presented unique problems considering the range of learner needs (Rolzinski, 1986, p. 93). She noted, at its most basic level, collaboration involved a single academic community working with a single business community, adult community, or labor community, and at its most advanced level, collaboration involved many organizational communities (1986, p. 93). The traditional roles of academia to collect and examine data and to explore ways of stating problems were valuable skills in helping community groups perceive how to develop the best possible strategies to mitigate large economic forces that affected them (Rolzinski, 1986, pp. 94-95). In addition, the traditional human resource development role of academia made

of topics, such as advanced technology, exporting, new business development priorities (AASCU, 1986a; Doyle & Brisson, 1985), and they raised these items of higher education human resource efforts aimed at community needs:

> **Establish advisory councils and other linkage mechanisms to keep in touch with community needs** (AASCU, 1986a, p. 48).
>
> **Build capacity through symposia and conferences involving diverse community groups including business, labor, and local government leaders and faculty to address economic development priorities** (AASCU, 1986a, p. 16).
>
> **Educate policy makers and the general public about university resources that could promote local economic development** (Doyle & Brisson, 1985, p. 18).

Although several aspects of the increased importance of the role of higher education in human resource development were noted, the major theme in the literature underlying human resource involvement in economic development was change: changes in administrative attitudes toward faculty (AASCU, 1986a; Doyle & Brisson, 1985; Lynton & Elman, 1987; Peters and Fusfeld, 1983; WHSC, 1986); changes in administrative perspectives of client needs with regard to format, location, and timing of instruction (AASCU, 1986b; Hodgkinson, 1985; Lynton & Elman, 1987; Matthews & Norgaard, 1984; Osborne, 1987; Preer, 1984; Southern Growth Policies Board, 1986; WHSC, 1986; Useem, 1986); and changes in the organization of knowledge (AASCU, 1986a; Botkin et al., 1982; Choate & Linger, 1986; Doyle & Brisson, 1985; Levine,

1984; Li, 1980; Moos, 1981; NEBHE, 1987; Reich,1989; WHSC, 1986).

The next section reviewed the changing role of institutional research to provide decision makers inside and outside the institution with a comparative data base for analysis and evaluation of policy objectives.

Research, Analysis, and Evaluation

One of the most consistent problems noted in the review of the literature was the apparent paradox of higher education institutions' perceived mission to gather and disseminate knowledge and their inability to utilize adequately a data base in order to make comparisons and evaluations regarding: internal operations and strategic planning (Byron, 1984; Cope, 1986; Jonsen, 1986; Keller, 1983; Matthews & Norgaard, 1984; Miller & Clark, 1983; Moos, 1981), higher education and state economic development activities (Beachler, 1985; Bernstein, 1986; Botkin et al., 1982; Matthews & Norgaard, 1984; Miller & Clark, 1983; Siegel, 1988), university-industry interaction (Melchiori, 1984; NSF, 1982; Peters & Fusfeld, 1983; Stankiewicz, 1986), and empirical research of university innovation initiatives with businesses, state and local governments, and communities (Baldridge & Deal, 1977; Gray, Johnson, & Gidley, 1987; Solomon & Tornatzky, 1986; Tornatzky, 1983). Osborne complained that state and federal efforts to upgrade capacity by analyzing data on the American economy were

stymied by a "hopelessly fragmented and out-of-date" federal data collection system that left those engaged in economic development at all levels "to fly blind much of the time" (1987, p. 71).

The lack of leadership and the inability to develop an environment in which information management strategy integrated software data bases and advanced telecommunications systems while ostensibly assuming the role of transmitting accumulated knowledge were contradictions in terms and seriously undermined the role of American higher education in economic development (Bernstein, 1986; Botkin et al., 1982; Peters & Fusfeld, 1983). The following item delineated this concept:

> **Standardize data bases that can be linked for internal comparison and analysis (e.g., if data bases for academic programs and personnel were linked for a program review, an analysis of tenure density, rank distribution, and retirement probabilities are then possible)** (Moos, 1981, p. 261).

Management information system (MIS) referred to a set of activities required to manage, process, and use information as an organizational resource (House, 1983, p. 90). MIS was based on the premise that the total organization is a system and the need to obtain relevant data describing the external environment was a necessity to the manager responsible for entering data (Drechsler & Bateson, 1986, p. 53). Byron contended the lack of a sufficient data base was clear evidence that "most [postsecondary] institutions not doing strategic planning

[either] do not know how, or do not understand its value" and suggested that MIS data minimally be collected from five categories: (a) students, (b) academic programs, (c) facilities, (d) finances, and (e) personnel. The following supported this contention:

> **Collect data every term that minimally includes: (a) students, (b) academic programs, (c) facilities, (d) finances, and (e) personnel** (1984, p. 28).

In Academic Strategy, Keller referred to environmental scanning as an intrinsic part of strategic planning and emphasized it as the "single most important contribution to organizational decision making" because "three-quarters of all change at most institutions of higher learning is now triggered by outside factors" (1983, p. 145). In addition, Cope emphasized the significance of data availability in effective strategic planning and suggested that information follows purpose in a manner similar to the architectural dictum that form follows function (1986, p. 73). Jonsen (1986) in an article for New Directions for Institutional Research entitled "The Environmental Context for Postsecondary Education" extended the environmental context for higher education decision making to include six distinct sources of information: (a) demographic, (b) political, (c) economic, (d) organizational, (e) technological, and (f) socio-cultural. In addition, Jonsen contended the rapid pace of environmental change constituted a qualitative difference in the need for academia to understand external

environmental factors and to adapt to its challenges and opportunities because the external environment not only determined what the institution will be to a considerable extent, but failure to identify compelling environmental influences would result in consistent reactive rather than proactive, strategic decision making (1986, p. 7).

Thus, higher education administrators who accurately assessed institutional needs by utilizing advanced technological processes could improve any strategic plan. Moreover, it is hoped that any strategic plan that streamlined the institutional mission, role, and scope would become an integral part of the rational decisionmaking process. Consequently, the following items sought to improve evaluation and productivity by more accurate allocation of scarce state resources through rational rather than political decision making processes:

> **Maintain an MIS within the office of institutional research to diagnose problems and analyze alternatives in policy analysis, needs assessment, forecasting, impact predictions, strategic planning, economic development** (Moos, 1981, p. 263).
>
> **Evaluate the institutional data base requirements of all personnel throughout the organization who may need to access information for decision making** (McLaughlin et al., 1987, p. 83).
>
> **Establish policies that reflect the needs of all personnel affected by or involved in access to information for decision making** (McLaughlin et al., 1987, p. 83).

The problem of data collection and analysis began in the mid-1960s when complicated technology and high equipment

cost helped create a technical subculture about the time that "institutional research emerged as a profession, [thus] scientific decision making was just coming of age [and] those in the management information and analysis function (MIAF) were protected by those they served and insulated from [administrators] by the neo-mysticism of their craft" (McLaughlin et al., 1987, p. 82). The office of institutional research essentially entailed manipulating data for usable information in strategic decision making. Moreover, as administrative emphasis shifted from long-range planning to strategic management (Cope, 1981; Jonsen, 1986; Keller, 1983), it was no longer sufficient "to use information simply to predict the future; consideration must also be given to the development of information in the present to influence the future" (McLaughlin et al., 1987, p. 83).

Moos (1981) contended that a comprehensive program to modernize institutional research and data collection and analysis should focus on three needs: (a) data bases, or categories of information, should be standardized throughout the institution so that comparisons are possible, (b) software should be introduced so that separate data bases can be linked for analysis (e.g., budget and academic programs, or students and academic personnel), and (c) the traditional counting role of institutional research should be transformed so that a full MIS is born, allowing data to be used for needs assessment, policy analysis, forecasting,

impact predictions, and the like (pp. 261-262). The following items reflected the contention of Moos that adequate data collection and analysis required cooperation from institutional research:

> **Establish guidelines to transform institutional research into a management information system** (Moos, 1981, p. 262).

Warren noted that advances in microtechnology to interface mainframes to microcomputers in remote sites at low costs to other campuses and to other institutions would form the educational networks of the future (1987, p. 35). Light speed communication networks have created marketing techniques that have increased the ability to diffuse technology from university to industry, from discipline to discipline, from one industrial sector to another, from large industry to small, and have become the basis for commercialization of technology (AASCU, 1986a; Doyle & Brisson, 1985; Moos, 1981; Peters & Fusfeld, 1983; Osborne, 1987; U.S. House of Representatives, 1971). A 1987 strategic plan for the Alabama Cooperative Extension System (ACES) reported

> Every county Extension office is linked by computer to on-campus data bases as well as to other information sources. That system opens new doors for rapid information transfer, and it provides us with more efficient and economical internal data management as well. (p. 38)

The establishment of such networks are crucial components of modern universities and support the following item:

Provide cooperative extension networks with access to on-campus data bases to diagnose problems and analyze alternative economic development strategies.

The lack of data on university-industry interaction that prevented trend analyses was specifically noted. For example, Peters and Fusfeld (1983) charged that "comprehensive data on total amount of industrial support was unavailable at most institutions--even for the current fiscal year. Not one institution could provide data on trends in industrial support of university research with industry in the last three decades" (p. 12). Others maintained that "despite numerous studies which have been carried out during recent years, our knowledge of the actual performance of different university-industry interfaces continues to be patchy . . ." (Stankiewicz, 1986, p. 96), and "while it would seem quite natural for the corporate side to conduct cost-benefit analyses, universities typically have no good handle on evaluating the impact and utility of their commercial partnerships" (Melchiori, 1984, p. 21). Bernstein compared the data base of higher education to industry and justifiably complained that "private industry could not succeed with a data-collection system and research base as weak as this nation has in the field of education" (New York based Committee on Economic Development cited in Bernstein, 1986, p. 29). The following item resulted from the need to support outside research of higher education by maintaining adequate data:

> **Maintain a data base of university-industry interaction for longitudinal trend analysis** (Peters & Fusfeld, 1983, p. 12).

Finally, if higher education is to develop a pivotal role in the emerging economic development triad of university, industry, and government interaction, then an adequate analysis over time demands an empirical data base for future comparison and evaluation (Baldridge & Deal, 1977; Gray et al., 1987; Solomon & Tornatzky, 1986; Tornatzky, 1983). The following item recognized the need for implementation of such a data base:

> **Maintain an empirical data base for comparison and evaluation of innovation processes between university, industry, community, state and local government interactions** (Tornatzky, 1983, p. 9).

Clearly, if data collection was "hopelessly fragmented and out-of-date" at the federal level (Osborne, 1987, p. 71), then it is imperative for economic survival that states empower their institutions of higher education to maintain adequate data bases that can be linked for analysis. Equally important as having the information available when needed was the necessity of competent and skilled leadership to act upon that information. Academia is in a perfect position to provide both. Consequently, if economic development strategies are contingent upon policymakers' accurate analysis of information, then having the capacity to act is equally important. The next section addresses the role of higher education in increasing capacity at the local, state, and national level.

Capacity Building

Capacity building or a capacity-creating aspect of investment was defined as an effect of investment spending on the productive capacity (the ability to produce goods and services) of an economy (McConnell, 1987). Essential steps in capacity building for economic development required efficient and effective supply and coordination of human resources and infrastructure in the development of markets and the involvement of entrepreneurs (Osborne, 1987). Osborne observed capacity building not only required new commercial activity but stressed, "No amount of new roads, sewers, plants, convention centers or even businesses financed by government will do that, unless local actors become entrepreneurial themselves" (1987, p. 68).

A recent article in Barron's cited U.S. Commerce Dept. figures that showed construction on public works down from 2.3% of GNP to about 1% of GNP over the past 20 years (Laing, 1988) leaving the infrastructure of America and its economic health in jeopardy (Szabo, 1989). For example, over 60% of U.S. paved roads was deemed by the Federal Highway Administration to be in need of resurfacing or complete reconstruction and 35% of the Interstate Highway System will have exceeded its designated life by 1990 (Laing, 1988; Szabo, 1989). Consequently, the conclusion of the National Council on Public Works Improvement was not encouraging: "The quality of America's infrastructure is

barely adequate to fulfill current requirements and is insufficient to meet the demands of future economic development" (Szabo, 1989, p. 16). Moreover, Laing (1988) reported no new major commercial airports have been built since the Dallas-Fort Worth Airport opened in 1974, while aviation experts estimated 1987 scheduling delays cost passengers and shippers over $3 billion in time and fuel losses. The story was much the same with the nation's 575,000 bridges, and likewise, the waterways, dams, waste-water/sewage systems, and water supply were all reported to be in poor shape (Laing, 1988, p. 8).

Alarmingly, the deterioration of the national public works infrastructure was rivaled by that of higher education facilities and scientific equipment. The significant decline since the late 1960s in American university physical plants, libraries, laboratories, and research equipment (Bloch, 1986; Matthews & Norgaard, 1984) could cost $1 billion to $4 billion to upgrade with maintenance costs of 7% to 8% of the original purchase price per year (Matthews & Norgaard, 1984, p. 90). The impact of this decline seriously diminished the physical and financial capacity of higher education to prepare adequately graduates in a rapidly changing global economy, especially in the sciences and engineering fields where economic growth requires technological innovation (Botkin et al., 1982;

Choate & Linger, 1986; Doyle & Brisson, 1985; Peters & Fusfeld, 1983; Osborne, 1987; WHSC, 1986).

David Packard, chairman of the White House Science Council, in testimony before the U.S. House of Representatives noted "the median age of university scientific equipment is twice that used in industrial labs and [impairs] the ability of academia to upgrade at a fast enough rate to ensure adequate future levels of scientific productivity" (WHSC, 1986, p. 20). He also identified three major steps the Federal Government must take to undo the damage to higher education, America's "most important scientific and technological resource": (a) increase commitment for basic research and establish special funding to halt the spread of physical plant and equipment decay, (b) provide full funding of all university research rather than cost sharing, and (c) promote basic research as a long-term investment rather than as an exercise in procurement (WHSC, 1986, pp. 21-22). Specific recommendations for improving higher education science and engineering infrastructure also were offered through this council in A Renewed Partnership, a report from the Panel on the Health of U.S. Colleges and Universities (1986) to the Office of Science and Technology Policy. Although the Panel's recommendations were aimed at federal agencies, their impact on the productive capacity of higher education

infrastructure demanded the advocacy of research administrators as well and included the following items:

> **Advocate a facilities fund dispersed through a National Science Foundation peer review process (50/50 matching) over a 10-year period to bring academic infrastructure up to acceptable research standards** (WHSC, 1986, p. 74).
>
> **Promote amortization of new academic facilities be reduced from the present 50 years to 20 years** (WHSC, 1986, p. 74).
>
> **Promote reducing depreciation of equipment/instrumentation from the current 15 years to between 5 and 10 years depending upon the precise nature of the equipment/instrumentation involved** (WHSC, 1986, p. 74).
>
> **Encourage federally funded research grants be allocated for at least 3 years and preferably 5 years** (WHSC, 1986, p. 86).
>
> **Advocate greater flexibility of federal funding that allows investigators discretionary use of up to 10% of research monies** (WHSC, 1986, p. 65).
>
> **Encourage high-risk research of investigators with a proven track record** (WHSC, 1986, p. 65).
>
> **Advocate federally funded block grants that encourage multidisciplinary and regional university cooperation** (WHSC, 1986, p. 65).

Collins (1986), in an analysis of the Economic Recovery Tax Act of 1981 (ERTA) for capital expenditures for research and development, found that some argued the incremental feature provided no tax savings and no real incentive while others argued it did (p. 212). Collins found evidence that the credit does provide a tax incentive, "but the punch of the incentive in many circumstances is diluted and in some circumstances it is nonexistent" (1986, p. 212). She explained:

> The dilution [of the 25% rate] occurs because of the way in which this particular incremental credit is structured. Under the ERTA credit, an increase in research and development spending this year increases the amount of credit earned this year, but it also increases the base value for future years which reduces the potential amount of future credits. (1986, p. 212)

The report from the Panel on the Health of U.S. Colleges and Universities agreed with the assessment of Collins and strongly urged that, rather than be incremental, the tax should be for full credit in order to promote rebuilding of obsolete facilities and equipment as well as for the establishment of a tax deduction equal to the full market value of industrial equipment and instrumentation contributions (WHSC, 1986, p. 65). The following items were also aimed at federal agencies, but were deemed strategically important in rebuilding the capacity of college and university infrastructure and deserved the advocacy of research administrators:

> **Advocate a 25% full tax credit for industrial funding of academic based research** (WHSC, 1986, p. 65).
>
> **Advocate establishment of a tax deduction equal to the full market value of all industrially contributed equipment/instrumentation** (WHSC, 1986, p. 65).
>
> **Promote tax credit for industry-supported maintenance and servicing of donated research equipment** (WHSC, 1986, p. 65).

Another aspect of academic involvement in capacity building for economic development occurred whenever institutions assumed the role of facilitator-teacher (AASCU, 1986a, p. 16). For example, institutions that worked with regional or local community groups, ranged from large

public-private planning organizations to small nonprofit development corporations and neighborhood groups, helped them define their problems, identified various resources, analyzed alternatives, and found unique solutions to those problems (AASCU, 1986a). Institutions contributed to grass-roots economic development by utilizing traditional problem-solving abilities of faculty, transferring these skills to local individuals and organizations, and involving diverse community groups in collaborative efforts to implement solutions (Crosson, 1986). Furthermore, a characteristic of successful higher education economic development activity has occurred whenever institutions have communicated with industry, state and local government, and community leaders and matched academic capacities with the needs of their service area rather than attempt to do what they are not qualified to do (AASCU, 1986a). The following items supported the necessity of higher education to identify those specific service area needs and develop the institution's capacity to its potential in those areas:

> **Establish advisory councils and other linkage mechanisms to keep abreast of the needs of the service area** (AASCU, 1986a, p. 48).
>
> **Develop centers for excellence that focus on existing service areas in which the institution has expertise** (AASCU, 1986a, p. 23).

Successful higher education capacity building initiatives emphasized providing financial and management assistance to entrepreneurs and inventors (AASCU, 1986a;

Chmura, 1987). In some cases, particularly Michigan, the state legislature authorized use of a portion of the public employee pension fund for venture capital to rebuild the declining manufacturing infrastructure into factories of the future (Osborne, 1987). Current trends for fostering creation of new technologies involved collaborative efforts between industry and higher education called research and development limited partnerships (RDLPs) that are conservatively estimated to comprise 20-25% of all U.S. research and development expenditures by 1990 (Souder, 1986, p. 289). In any event, overcoming three decades of neglect will require substantial capital investment and will necessitate increased brokering efforts on the part of higher education research administrators to match capital to entrepreneurs and raised this item:

Develop linkage mechanisms between venture capital networks and entrepreneurs.

Expanding markets are crucial to American debt reduction, and creating the capacity to take advantage of world market demand by providing export assistance to small and medium size firms has become a role of higher education (Moos, 1981; Osborne, 1987). A recent article in Nation's Business reported that over 60% of U.S. export trade was conducted by small firms that exported less than $25,000 (Golob, 1988). He found that the major deterrent to more small firm export participation was the paperwork which was the same regardless of the amount exported, and that the

solution involved computer software assistance to reduce the amount of time involved in complying with trade regulations (Golob, 1988). This example presented an illustration of the contribution to economic development by utilizing faculty technical skills to increase the productive capacity of local business, and the following items reflected these capacity building initiatives:

> **Develop research strategies that monitor potential foreign markets for state industries** (Osborne, 1987).
>
> **Provide mechanisms to encourage faculty assistance to small and medium size firms in export management** (Golob, 1988).

Finally, among the industrialized nations of the world, America is one of the few that failed to recognize human intellect as a national resource by not taking steps to support the young gifted student (WHSC, 1986). This item reflected the notion that the capacity of any nation ultimately rests on its most intellectually able:

> **Advocate full portable, merit-based scholarships to the most intellectually-able 1% of entering college freshmen** (WHSC, 1986, p. 86).

Thomas Chmura, program manager at the Center for Economic Competitiveness at SRI International, in an article based in part on research done in collaboration with AASCU (1986a), acknowledged the emerging roles of higher education in economic development from that study; however, he differentiated by combining the economic research and analysis role with capacity building to become economic analysis and capacity building, and included an additional

role called promotion of international trade (1987, p. 13). By merging the information analysis function into the capacity building component, Chmura reflected the singular importance of objective information necessary for state and local decision makers to diagnose accurately problems and to analyze alternative economic development approaches in formulating policy (1987, p. 13). Other studies of successful higher education economic development initiatives indicated similar findings: well-planned strategies were based on institutional needs assessment that identified strengths and weaknesses within their unique geographical region, and based upon that information, how postsecondary institutions could best support and develop capacity building goals and policy objectives for regional economic development (AASCU, 1986a, 1986b; Bernstein, 1986; Chmura, 1987; Doyle & Brisson, 1985; Hansen, 1988; NEBHE, 1987; Osborne, 1987; OTA, 1983, 1984a, 1984b; President's Commission on Industrial Competitiveness, 1984; Southern Growth Policies Board, 1986; WICHE, 1980).

Thus, expanding human resource development services; increasing importance of available accurate information shared through academic, state/local government, labor, business, and community networks; and the resulting forged alliances all have facilitated numerous capacity development efforts promoting a climate conducive to innovation (Chmura,

1987; Clarke, 1986; John, 1987). In such an innovative climate, new businesses could achieve optimal growth.

New Business Development

Traditionally, state economic development policy focused on attracting and retaining large companies (Morrison, 1986). This policy was challenged by a study in the late 1970s showing that between 1969 and 1976 businesses with fewer than twenty employees were responsible for two-thirds of all net new jobs (Birch, 1978). John (1987) noted a later study by Birch and MacCraken (1984), covering from 1977 to 1981, attributed 51% of all net new jobs to businesses with less than twenty employees (p. 74). The November issue of The Wall Street Journal (Wessel & Brown, 1988) challenged Birch's methodology and his latest figures that showed from 1981 to 1985 firms with fewer than twenty employees created 88% of all net new jobs. John, however, cited research by both Birch and MacCraken (1984) and Armstrong and Odle (1982) that agreed new establishments, large or small, contributed one-half or more of all net new jobs created (1987, p. 74). A Small Business Administration (SBA) study between 1982 and 1986 concluded, "Businesses with fewer than twenty workers were responsible for only 36.5% of all net new private sector jobs. Companies with fewer than 100 workers--the most common definition of a small business--were responsible for 51.5%" (Wessel & Brown, 1988, p. 31).

A National Governors' Association survey of economic development policies and programs concluded that while only nineteen states regarded the growth of business as a major component, all states provided some type of small business assistance ranging from: (a) setting up small business assistance centers to provide information on licensing and permitting, (b) providing procurement assistance, (i.e., helping firms obtain both state and federal government contracts); (c) offering technical assistance in the areas of business planning, financial management, accounting, marketing, and training; (d) assisting small businesses in obtaining financing from both public and private sources, even providing direct financial assistance (Clarke, 1986, p. 47). Yet, Clarke emphasized that although the primary purpose of state economic development strategies regarding small business programs was not to attract new industries to the state, "these programs can play a role in establishing the state's overall business climate, [and become] an important factor in any attraction effort" (1986, p. 48). The following items reflected Clarke's corollary regarding state economic development strategies for small businesses that may improve new business development opportunities as well:

> **Provide management and technical assistance to potential entrepreneurs including faculty** (AASCU, 1986a, p. 25).
>
> **Provide entrepreneurial assistance programs with emphasis on new business development, i.e., evaluation**

> **of technical feasibility, market evaluation, production costs, financial viability, and general business and management advice** (Clarke, 1986, p. 51).
>
> **Provide industrial extension agents who will work specifically with new and small businesses, e.g., market identification, management training, computer use, exporting, procurement assistance, patent and licensing arrangements** (Osborne, 1987, p. 62).

Peters and Fusfeld referred to "untapped potential in providing mechanisms which would facilitate the collaboration between the research programs of new business spin-offs and university research into economic development programs" (1983, p. 107). Doyle and Brisson (1985) noted small businesses were most in need of academic technical assistance while Johnson (1984) acknowledged academic financing of spin-offs was the newest university idea (pp. 10, 65). By 1983, higher education administrators were exploring alternatives promoting academic participation in new business development that included: (a) contributing institutional resources and space, i.e., small business incubators, research parks, entrepreneurial training programs, and innovation centers (Chmura, 1987; Clarke, 1986; John, 1987; Watkins, 1985a; Watkins & Wills, 1986); and (b) promoting creative financing arrangements that allowed the institution to benefit from involvement in new business development through risk-taking ventures such as financing incubator spin-offs with seed money, use of faculty consulting services, office space, and laboratory equipment in return for patent rights, licensing

arrangements, royalties, rents, and equity interest (Chmura, 1987; Doyle & Brisson, 1985; Johnson, 1984).

Technology research centers often referred to as centers for excellence or advanced technology centers were mechanisms for conducting university research in a specific technological area in which the institution had expertise or that was particularly pertinent to the state's major industries (Clarke, 1986, p. 59). According to Clarke such centers were designed: (a) to attract new industry, (b) to encourage the creation of new firms through the spin-off of new products and processes, or (c) to help solve technological problems of existing industries (1986, p. 59). The chief advantages of research centers were creation of a reservoir of basic technological knowledge and human expertise to support future industrial capacity (Watkins, 1985a). Watkins found centers particularly important for states without exceptionally strong universities or where a single technology is crucial to declining industry in overall state economic development (1985a, p. 33).

Although research parks were not a recent phenomena (Stanford's Silicon Valley established in the early 1940s and North Carolina's Research Triangle Park established in the early 1950s), Clarke cited a 1983 National Governors' Association survey that identified eighteen states that either had, or were in the process of establishing, research parks (1986, p. 60). A by-product of research parks

included development of essential infrastructure such as transportation, utility services, and communications to support new business growth (Waugaman, 1986, p. 274). Several studies, however, have warned localities against expecting to replicate the success of Silicon Valley, Route 128, or Research Triangle Park because of the lack of technological or financial infrastructure to accommodate such growth (OTA, 1984b; Watkins, 1985a; Watkins & Wills, 1986). Dick Thornburgh, former Governor of Pennsylvania, explicitly warned, "each state must marshall its own particular resources to address its own specific problems" (1988, p. 209).

The NSF Innovation Center Program was established in 1973 to promote student entrepreneurialism through higher education multidisciplinary and clinical experience in the commercialization of new products and processes (Clarke, 1986). Clarke reported the program specifically gave students an opportunity to assist in product testing and evaluation, and in setting up incubator facilities (1986, p. 73). When the program terminated in 1981 and became NSF's University-Industry Cooperative Research Centers, the evaluation of the old program revealed that the NSF invested a total of $5 million over five years in ten centers and out of 30 new ventures, 23 reached the market with sales exceeding $30 million, 1,000 new jobs created, and over $6 million in tax revenue generated (Clarke, 1986, p. 73).

Clarke cited a study by Scheirer (1986) that found the most successful centers worked primarily with new businesses, rather than existing ones and provided intensive business and marketing services to a limited number of clients (1986, p. 73).

Clarke identified higher education entrepreneurial assistance and training programs which served to evaluate ideas for commercial viability through technical advice, limited testing, market evaluation, and management advice (1986, p. 68). Watkins and Wills noted some programs have developed technological innovation programs which focused more on business (as opposed to product) aspects of entrepreneurial training and assistance (1986, p. 81). Also, incubator facilities were used to support new, small business by providing low-rent office and lab space (Clarke, 1986, p. 68). Additional on-site support services such as office services, computer access, and on- or off-site management and technical services were offered on a referral basis (Watkins & Wills, 1986, p. 81). Clarke cited a 1985 study by the National Council for Urban Economic Development (CUED) that identified 70 incubator facilities with a median starting age of 1983 for all such facilities and noted that the overall success rate was 1.9:1, compared to that of the general business environment where nearly four times as many new businesses failed during their first five years (1986, p. 69).

A crucial aspect of all these university interactions involved creative financial arrangements that allowed the institution to benefit financially from involvement in new business development through risk-taking ventures such as financing spin-offs with seed money, use of faculty consulting services, office space, and laboratory equipment in return for royalties from patent rights, licensing arrangements, as well as rent and equity interest (Chmura, 1987; Clarke, 1986; Watkins, 1985a). Small and medium sized firms tended to form permanent attachments to the state in which they were located; consequently, the institution was more likely to capture the benefit of such targeted investment over the long term (Tucker & Mandel, 1987).

Moreover, higher education participation and financial involvement in the creation of new businesses attracted the advanced technology sector, in particular, thereby creating additional academic science and technology capacity for economic development (Peters & Fusfeld, 1983). The following items were derived from higher education involvement in the promotion of new businesses for economic development:

Develop mechanisms that stimulate new business development, e.g., incubators, research centers, entrepreneurial training programs, and innovation centers.

Negotiate, prior to actual involvement, expected financial benefits (i.e., royalties, rents, equity ownership) in return for institutional seed money, use of faculty consulting services, office space, and laboratory equipment.

Several studies reported that, due to the relative newness of the program, there was limited data to evaluate university promotion of new businesses for economic development (Clarke, 1986; John, 1987; Watkins, 1985a). A 1985 National Governors' Association study (Clarke, 1986) identified several kinds of state technology programs, including applied research and development grant programs, centers of excellence, technology transfer programs (e.g., industrial extension services, grants for technology evaluation studies, and linkups to interactive data bases on technologies), research parks, and special funding for buildings and equipment to enhance state university research capabilities. State government research and development initiatives usually focused on funding gaps between basic research and full-scale commercialization and targeted, through university-based research centers or applied research and development grant programs, technological areas of importance to key state industries (John, 1987, pp. 97-98).

Although it would be futile for the majority of postsecondary institutions to emulate major research universities (Preer, 1984), smaller institutions have begun to concentrate their limited resources on well-defined niche areas and building new partnerships with major research universities, state government programs, industries, and communities (Chmura, 1987). In addition, a number of

relatively new research approaches and relationships have been developed, i.e., university-industry cooperative research centers, industrial affiliates, and joint industry-state research programs (Chmura, 1987). For example, a National Science Board study (Peters & Fusfeld, 1983) of 463 higher education institutions noted that 51% university-industry interactions had existed only since 1981; and a 1985 CEUD study gave the median starting date of incubators as mid-1983 (Clarke, 1986, p. 69). Although such experimentation is desirable, there is additional need to evaluate the results of different approaches. Yet, the lack of comparable data of university-industry interaction makes comparisons between successful and unsuccessful approaches difficult. Articulating policies that reflected the institutional mission and capacity to promote new business development would establish a basis for setting measurable program goals (Doyle & Brisson, 1985). The need for data to be used as a benchmark for comparative analysis and evaluation of trends led to the following item:

> **Set measurable goals for data analyses and evaluation of institutional programs promoting new businesses for economic development.**

Finally, John referred to a 1985 SBA study that found individual entrepreneurs in small or new businesses were an especially productive source of innovation (1987, p. 108). He observed that while some small firms were technology-intensive, growth-oriented, and innovate, many were not; and

he concluded, "Perhaps small business programs should be redesigned to emphasize newness, entrepreneurship, and technology intensity rather than smallness per se" (John, 1987, p. 108). That conclusion is precisely the point.

The role of higher education in technology development demanded a degree of adaptability in redesigning existing organizational structures into more effective and efficient networks for training managers of technology who could guide new products and processes through commercialization, as well as institutional mechanisms to promote development of new products and processes.

Technology Development

Although the term technology was used extensively in the literature, there was little consensus on its precise definition. Whatever it was, technology did not refer to a "thing," rather the essence of it incorporated a state of knowing either through study or experience (Mogavero & Shane, 1982), or a body of knowledge that explained the systematic organization of the production process (Holt, 1987; Johnson, 1989). The evolution of technology, in addition to connoting mere possession of technological knowledge, also included its potential for practical application for social needs, thus introducing the concept of values (Sample, 1988). Consequently, Sample contended science was value-neutral (i.e., the study of things as they are) while technology was value-laden (i.e., changing things

from the way they are to the way some person or groups would like them to be) and concluded, "In this sense physiology is science, and medicine is technology; physics is science, and engineering is technology; biochemistry is science, and agriculture is technology" (1988, p. 57). Thus, for the purpose of this study, technology denoted a body of scientific, technical, and managerial knowledge developed by an individual or group to introduce new products and processes.

The role of higher education in technology development and transfer has been the focus of several studies (AASCU, 1986a; Chmura, 1987; Gray et al., 1986; Logan, 1984; Lynton & Elman, 1987; Peters & Fusfeld, 1983; Watkins, 1985a). Although the process of successfully transferring research results into commercial products has not been well understood (Peters & Fusfeld, 1983; Watkins, 1985a), the concept of the role of the university in the process as solely a generator of ideas has evolved to include synthesis, evaluation, and application of knowledge as well (Lynton & Elman, 1987). Thus, while academia has a strong role in technology development and transfer, it is not the only participant. David Swanson, director of the Center for Industrial Research and Service at Iowa State University, explained that, in the past, the major role of the university knowledge transfer took place in the classroom, but its role in today's economic growth has expanded to

include: development, coordination, communication, needs assessment, integration, and cooperation of industries and government agencies (1986, p. 25).

Although increased availability of hardware, software, and operating systems has made information more accessible to higher education institutions, businesses, and state and local governments (Warren, 1987), Beyers et al. (1987) found scant computer data on the comparative advantages of the nation's higher education institutions that could be used to influence corporate siting decisions (p. 17). Yet, Swanson reported that several surveys indicated industry sought academia's informational and technical expertise more than that of government agencies and perceived that education as a source of technical information was not being utilized to its fullest extent in transferring that information (1986, p. 29). An effort to improve the transfer of knowledge from academia to specific users will require development of data bases that provide industry, and appropriate government agencies access to researchers (Aldridge, 1986, p. 26). The following items promoted these goals:

> **Develop organizational mechanisms for synthesizing faculty research for data processing.**
> **Maintain a computer data base inventory of all faculty research** (Aldridge, 1986, p. 26).
>
> **Provide industries and appropriate government agencies access to relevant faculty research activities specifically for aiding economic development** (Aldridge, 1986).
>
> **Provide a directory of institutional services that might facilitate product or process technology transfer**

to businesses, state/local governments, and communities.

A classic framework of technology development included three distinct steps: (a) Invention is the act of conception that requires a knowledge of available technological resources and an understanding of society's wants and needs; (b) innovation is the introduction of new ideas, processes, or inventions into the economy of society that requires investment of money or resources, an services of entrepreneurs, and usually involves substantial risk; and (c) diffusion is basically an educational/informational transfer process spreading new technology throughout the whole industry or to other industries and disciplines (U.S. House of Representatives, 1971; Shrum, 1985). Although the entire process incorporated technology transfer, in the invention and innovation steps technology was transferred vertically from research and development through production to the market while diffusion or horizontal transfer could occur during any stage in the vertical transfer process (Li, 1980). The organization of the American economy was best suited to vertical technology transfer, and consequently explained a bottleneck in the higher education diffusion process (U.S. House of Representatives, 1971).

Semantical differences in usage of these terms has posed a problem in university-industry research expectations. For example, innovation in industry usually referred to the total process of technological change (i.e.,

invention plus exploitation) while the professor's idea of innovation often implied a breakthrough or totally new concept, idea, or approach, thus leaving the responsibility for others with the knowledge of societal wants and needs to commercialize innovation (Peters & Fusfeld, 1983, p. 36). In the future, successful university-industry interaction, however, will depend to a great extent upon faculty assuming a more practical research outlook that integrates the commercialization of new products and processes (Lynton & Elman, 1987; Matthews & Norgaard, 1984; NSF, 1982; Peters & Fusfeld, 1983).

Thus, a crucial aspect of technology transfer involved better understanding of basic terms and diffusion processes on the part of academic administrators as it related to their specific institutional mission goals and prompted these items:

> **Develop a specific program for diffusion of university technological products and processes for economic development** (AASCU, 1986a, p. 23).
>
> **Provide knowledge transfer mechanisms that support industrial, professional and community economic development needs.**
>
> **Provide a campus-wide interactive data base which includes information on faculty research activities.**

Although the differences between academic and industry approaches to research have been noted (Botkin et al., 1982; Lynton & Elman, 1987; Matthews & Norgaard, 1984; Peters & Fusfeld, 1983), additional studies found personnel exchanges an opportunity to acquaint university scientists with

applied research needs and to introduce industry and government scientists to potential employees and basic research (Doyle & Brisson, 1985; Peters & Fusfeld, 1983). The following items generated from the literature supported these claims for a mutual understanding among all parties involved in the knowledge transfer process:

> **Promote faculty sabbaticals in laboratory settings, e.g., industry, economic development agencies, federal laboratories** (AASCU, 1986a, p. 23).
>
> **Encourage faculty access to industrial and federal laboratories in personnel exchanges that also allow laboratory scientists to teach in classrooms for one term** (Doyle & Brisson, 1985, p. 23).

University-industry interaction involving technology transfer historically has been an issue of contention often because the research needs of each have been at odds (GUIR, 1986; Lynton & Elman, 1987; Matthews & Norgaard, 1984; NSF, 1982; Peters & Fusfeld, 1983). For example, industry research and development programs were planned with a specific goal and timetable; however, because of university proprietary and time constraints, industry rarely looked to them for new product and process innovation except for unique advanced technology situations such as gene splicing (Peters & Fusfeld, 1983). As a result of these differences, myriad problems arose regarding: patent and licensing restrictions (Gray et al, 1986; Peters & Fusfeld, 1983); pre-phase agreement and contractual negotiation difficulties (Allen, 1987); and proprietary rights versus academic freedom (Gray et al, 1986; GUIR, 1986; Lynton & Elman, 1987;

Matthews & Norgaard, 1984). Resolution of these problems increased as university administrators recognized that mutual understanding and clarification on a one-to-one basis were essential before beginning any research project (Doyle & Brisson, 1985). The following items reflected the need to promote increased university-industry technology transfer for economic development:

> **Establish specific institutional guidelines for faculty consulting regarding conflicts of interest and academic freedom** (Doyle & Brisson, 1985).
>
> **Provide equitable compensation for faculty consulting and reward public service contributions that contribute to economic development** (AASCU, 1986a, p. 54).
>
> **Develop mechanisms to facilitate product commercialization through patent filing, patent management, and patent licensing** (AASCU, 1986a, p. 54).

Finally, regarding successful technology development, one inescapable overall conclusion remained that the major technological problems were often not technological in nature; rather they stemmed from political, economic, or social impediments to innovation and required change agents to plan, implement, and track most successful change efforts (London, 1988). Elimination of these structural impediments required public policy that established a climate conducive to innovation (John, 1987). In fact, higher education has become a critical player in establishing links between public and private sector commercial investments (Bernstein, 1986) and in a very real sense is responsible for setting a tone that provides encouragement to potential entrepreneurs

and inventors in knowledge transfer for economic development.

Measurement Theory

The Instrument

A review of the literature revealed a scarcity of empirical studies on specific activities proposed in this study, and no instrument was found that measured the dimensions proposed in this study. Therefore, information for this study was obtained through the use of a questionnaire. Part I of the survey instrument was used to collect demographic data from the respondents that was not available on the institutions' characteristic data type on file with the U.S. Department of Education. Part II of the instrument (HEEDS) was developed to measure the level of higher education involvement in economic development with respect to presently occurring activities supported by the perceptions of research administrators at state universities and land grant institutions. A list of survey items was generated from a review of the related literature involving higher education in state economic development strategies. The literature review yielded 57 items that suggested a variety of activities that encouraged academic involvement in economic development. All survey items began with a verb form to connote activity explicit in the scales and followed set procedures to enhance clarity by: (a) avoiding long questions, (b) avoiding words with double meanings or

ambiguous usage, (c) avoiding negatives, (d) avoiding two-part questions (Russell, 1985, p. 158).

In this study five theoretical dimensions representing higher education-economic development were reduced from seven broad categories that described the "spectrum of new university roles in economic development": human resource development, economic research and analysis, capacity building, technical assistance, research, technology transfer, and new business development (AASCU, 1986a, pp. 10-11). Initially, two procedures for generating a sample of items that addressed issues in these five dimensions were devised to obtain measures of current economic development involvement at state universities and land grant institutions. First, content validity of the items was judged by a nationwide panel of three experts in a controlled evaluation process to determine empirically the content validity of each item called the index of item-objective congruence (Rovinelli & Hambleton cited in Hambleton, 1980, p. 80). Second, a preliminary survey and a survey item review form were mailed to a panel of eight judges. In addition, a preliminary survey and protocol were submitted to the Auburn University Institutional Review Board requesting HEEDS exemption from a formal technical review concerning federal guidelines with respect to experimentation of human subjects. The request was granted. Finally, based upon the results of these controlled

evaluations, items were either corrected or eliminated and HEEDS along with a a cover letter and definition of terms were mailed to the population of research administrators.

Rating Scales

Scaling may be used for the purpose of describing a data structure, i.e., for discovering the latent dimensions underlying a set of obtained observations (McIver & Carmines, 1986). For example, HEEDS attempted to specify the dimensions underlying the perceived frequency of higher education involvement in a variety of economic development activities. No hypothesis was being tested. Instead, the purpose of this analysis was mainly exploratory with respect to the scales and mainly confirmatory with respect to the five underlying theoretical dimensions. Dual six-point summated rating scales measuring the perception of the extent of Presently Occurring Activities (what is) and the extent the activities Should Be Occurring (what is desired) of higher education research administrators were used in this instrument.

An additional category acknowledging the respondent had no knowledge of activity or a "don't know" (DK) filter was included in the Presently Occurring Scale and represented by a question mark (?). The DK filter was not given a numerical value and was reported as a total number of responses for the DK filter item. Although utilizing the DK filter for the study resulted in a varying number of

responses for questions on the perceptual scale measuring the present emphasis, it was intended to reduce the frustration level of the respondents when they were unaware of the existence or nonexistence of a particular economic development activity in their respective institutions (Schuman & Presser, 1978). Schuman and Presser (1981) found that survey instruments that offered DK as part of the response scale were more frequently used as an alternative response as the respondent's educational level rose, that is, it was the more educated individual who most readily admitted ignorance. Thus, allowing the respondent the option of a "don't know" should have lent greater accuracy to the interpretation of those perceived items the respondent rated other than the question mark in HEEDS and thereby reduced error in analysis (Bailey, 1987; Schuman & Presser, 1978, 1981).

Verbal estimations of frequency magnitudes in the dual six-point rating scales of this instrument were based on a study that suggested numerical values for the verbal estimations (Bass, Cascio, & O'Conner, 1974). The numerical values 5:4:3:2:1:0 (Appendix A) had scale properties having optimal statistical proportions with respect to assumptions ordinarily required for analyses based on correlational techniques. HEEDS has the characteristics of ordinal measurement (Adams & Schvaneveldt, 1985, pp. 158-159). Converse & Presser reported the stability of frequency

expressions--always and never--with numerical definitions of 100% and 0% respectively (1986, p. 29). This instrument incorporated dual six-point summated rating scales with each frequency expression approximating a mean scale value relation to each other of 5:4:3:2:1, the addition of a DK filter denoting a missing value (i.e., "?"), and ranges of time expressed in percentages corresponding to the dual six-point rating scale:

A. To what extent the activity is presently occurring.
?--No knowledge of activity (denotes missing value)
100%--Always
75-99%--Frequently, if not always
50-74%--Fairly often
25-49%--Sometimes
1-24%--Seldom
0%--Never

B. To what extent the activity should be occurring.
100%--Always
75-99%--Frequently, if not always
50-74%--Fairly often
25-49%--Sometimes
1-24%--Seldom
0%--Never

The collection of both the actual (presently occurring) and ideal (should be occurring) data enabled the researcher to distinguish between the "actual and preferred states [and] gives some protection against the danger that the respondent's perceptions of actual functions would simply be an expression of his own preferences" (Hansen cited in Kingry, 1984, p. 42).

Definitions

The survey instrument contained a list of definitions of terms to assure each respondent interpreted the activity statements consistently.

Summary

A thorough review of higher education-economic development literature not only revealed limited empirical studies on specific activities proposed in this study, but also found no instrument which applied to the dimensions similar to HEEDS. Therefore, the need was identified by the Auburn University Economic Development Institute to develop and validate a higher education economic development survey (HEEDS) instrument.

In order to develop and validate HEEDS, survey items were generated from a review of the literature related to higher education and economic development to measure the frequency of occurrence of economic development activities. In addition, a review of measurement theory literature related to instrument construction was described. As a result of the literature review, 57 items were generated to measure responses of research administrators on the current level of economic development involvement at state universities and land grant institutions. A further description of related validity and reliability principles involved in constructing the instrument was discussed in Chapter III, research methodology.

Finally, the 57 items represented five proposed dimensions: Human Resource Development; Research, Analysis, and Evaluation; Capacity Building; New Business Development; and Technology Development. These dimensions described linkages whereby higher education facilitated economic development activities with business, state and local government, and community leaders.

III. RESEARCH METHODOLOGY

Since ther inception, the mission of state universities ad land grant institutions embodied societal needs of a pratical and useful education for children of America's workng class. The denial of such democratic yearnings by mre clas..cal-oriented institutions only served to soliify the position of state universities and land grant coleges. By the late 1800s, the basis for the modern researc university had been established. With the addition of th vast cooperative extension network through the Smith-Leve Act of 1914, the distinctively unique American highe education system was unparalleled by any other in the wrld in terms of basic and applied research. In 1965, the federally mandated State Technical Services program (PL 89182) was designed to promote the "wider diffusion and more effective application of science and technology in industry" (House of Representatives, 1965, p. 2). The State Technical Services program designated a substantial nuber of state universities and land grant institutions to serve in a coordinating capacity transferring knowledge and offering technical assistance to American businesses.

By 1973, the current higher education economic development connection began in earnest (Bernstein, 1986). Historically, state initiatives to attract new industry had revolved around tax incentives and state/local subsidies (Morrison, 1986), but by the early 1980s that policy had evolved into community economic development efforts to improve the infrastructure in order to attract new industry (Malecki, 1987).

Increasingly, a key player in state economic development initiatives was postsecondary institutions (AASCU, 1986a). First, human resource development has undergone significant demographic changes that have altered the conventional academic wisdom and reinforced a number of basic factors regarding convenient, lifelong, continuing adult education with respect to format, location, and timing of instruction (Hodgkinson, 1985; Lynton & Elman, 1987; Moos, 1981; WHSC, 1986). Second, information management demanded adequate data bases that could be linked for analysis and leadership competent to evaluate and act upon that information (Jonsen, 1986; Moos, 1981). Third, in order to maximize capital resources required not only efficient coordination of human resources and the involvement of entrepreneurs in developing new legal, social, and economic infrastructures to serve new markets (John, 1987; Osborne, 1987), but also a comprehensive agenda to address the rebuilding of America's public works

infrastructure for the year 2000 and beyond. Fourth, initiatives to aid existing industry often played a key role in enhancing the overall quality of business climate and thereby became an important factor in attracting new businesses (Clarke, 1986; John, 1987). Fifth, the role of higher education in technology development has occurred primarily in the transfer of basic research and technical assistance (Peters & Fusfeld, 1983). Further, the fundamental problems in economic development are not technological in nature, rather they stemmed from political, economic, and social constraints to innovate (London, 1988).

By 1986, higher education became a critical player in establishing linkages between the public and private sector (Bernstein, 1986), and has been responsible for providing an objective forum for public policy debates to reduce structural constraints and thus set a tone for establishing a climate conducive to innovation (John, 1987).

The purpose of this study was to develop and validate a survey instrument measuring responses from research administrators at state universities and land grant institutions of current economic development involvement. Since no suitable standardized instrument existed for empirically measuring the frequency of these activities, Higher Education Economic Development Survey (HEEDS) was constructed according to the following steps: (a) identify areas that facilitate higher education economic development

involvement, (b) develop items to measure that involvement, (c) establish content validity of items, (d) establish technical quality of items, (e) identify the population for which the instrument was intended, (f) identify the appropriate methodological approach to obtain data, (g) develop an instrument format that was easy to read and to answer and that gave results easy to tabulate, and (h) establishment of time limits for various follow-up phases of the instrument if needed. The research methodology is discussed in this chapter.

Methodological Approach

The purpose of this study was to develop and validate an instrument that provided information about the frequency of economic development activities at state universities and land grant institutions, i.e., a status descriptive survey of the population of research administrators was being surveyed nationwide. A mailed questionnaire was deemed more practical and efficient than either telephone or personal interviews due to the time and expense involved (Van Dalen, 1979, p. 285). Furthermore, a questionnaire was considered a particularly appropriate method because it permitted ease of replication and thus provided an additional validity and reliability check (Webb, Campbell, Schwartz, and Sechrest, 1970, pp. 33-34).

Development of the Instrument

Much of the measurement research concerning content validation focused on criterion-referenced test development rather than on norm-referenced instruments (Guion, 1977; Messick, 1975; Popham, 1978); however, the need to confirm content was applicable to this study. The need for outlining steps to confirm content validation of the items generated through a literature review led to devising an appropriate method to analyze the content relevance of HEEDS (i.e., the match between item content and the dimensions the items were written to measure). Furthermore, because the items used in HEEDS to measure frequency were generated from a review of the literature, there was no predetermined domain or behavioral specifications to guide the researcher. Consequently, an a posteriori approach to item validation was chosen to assess whether or not a direct relationship between an item and its dimension existed through an analysis of data collected after items were written (Hambleton, 1980, p. 87). According to Standards for Educational and Psychological Testing, "Validity always refers to the degree to which the evidence supports the inferences that are made from the scores. The inferences regarding specific uses of a test are validated, not the test itself" (American Psychological Association (APA), 1985, p. 9). An ideal validation process includes a

combination of evidence reflecting the value of a test for an intended purpose:

> Content-related evidence of validity is a central concern during test development, whether such development occurs in a research setting, in a publishing house, or in the context of professional practice. Expert professional judgement should play an integral part in developing the definition of what is to be measured, such as describing the universe of content, generating or selecting the content sample, and specifying the item format and scoring system. Thus, inferences about content are linked to test construction as well as to establishing evidence of validity after a test has been developed and chosen for use. (APA, 1985, p. 11)

The a posteriori approach to determine item validation of HEEDS involved a consideration of three features: (a) content validity, (b) face validity, and (c) technical quality. Two separate, controlled, empirical, evaluation processes were used: (a) item-objective congruence by a panel of nationwide experts to determine content validity, and (b) a preliminary survey review by a panel of judges to determine the face validity and technical quality of each item of HEEDS. Finally, because HEEDS was designed to determine properties of the empirical domain of responses to economic development activities, a factor analysis was employed to enhance parsimony, a reduction of variables, through a dimensional analysis of the items. According to Gorsuch:

> Dimensional analysis occurs when an exploratory factor analysis is used to establish the structure or dimensions which are important to that area. The intent is to lay the groundwork for individual research programs on each of the dimensions analyzed and for more comprehensive studies relating the important

> dimensions of a particular area both to themselves and to other areas (1988, p. 256).

Thus, after content validity, face validity, and technical quality of HEEDS had been established, the research problem became one of determining whether or not the factor pattern matrix had a prescribed form. Hambleton noted,

> One would expect to obtain as many factors in a factor solution as there are objectives covered in a test, and with items 'loading' on only the factor (or objective) that they were designed to measure. Items deviating from this pattern should be carefully studied for flaws (1980, p. 96).

Finally, reliability of HEEDS was derived from Cronbach's coefficient alpha (Rummel, 1970, p. 356).

In summary, the responses by the panel of experts and the panel of judges to the item evaluation forms used in refining and revising the instrument before surveying the population constituted content validity and face validity as well as technical quality of HEEDS. Factor analysis established the basic dimensions for interpreting the observed data by analyzing inter-relationships among variables in such a way that the variables could be described adequately by a group of basic categories smaller in number than the original variables, i.e., parsimony (Zeller & Carmines, 1980, p. 18).

Survey Validity

Zeller & Carmines noted that in order to have a valid measure, one must have a reliable one, but the converse is not always true; consequently, reliability became a necessary but not sufficient condition for validity (1980, p. 7).

After elimination of one item from the original pool of 57 items on the basis of the item-objective congruence evaluations by the expert panel, the remaining 56 items in the instrument were deemed important variables in measuring the frequency of higher education economic development activities. It was presumed that the instrument was valid. Evidence for this assumption was provided by two evaluations based on responses from a panel of experts to determine content validity, and a panel of judges to determine face validity and technical quality of the instrument.

Evaluation of HEEDS by Panel of Experts

Supporting evidence for the validation of HEEDS came from two sources because no previous study had been directed to this particular population concerning this particular conceptual area. An examination of the literature review and the resultant items constituted the basis for content validation. Content validity refers to the "representativeness of the sample of questions included in the instrument" (Morris & Fitz-Gibbon, 1978, p. 96). Churchill noted "the key to content validity lies in the procedures

that are used to develop the instrument" (1976, p. 248), and Wright claimed that while it is practically impossible to determine content validity with a single statistical criterion, it is possible to "examine the literature carefully to find all the ways in which other researchers have measured the concept under investigation" (1979, p. 48). For evaluating the validity of a measuring instrument, however, one method required agreement among members of the panel (Nachmias & Nachmias, 1976, p. 62). Consequently, an a posteriori approach to item validation was designed to assess whether or not a direct relationship between items and the dimensions they intended to measure existed through an analysis of data collected after items were written (Hambleton, 1980, p. 87). Therefore, a subsequent evaluation of the literature review by three nationally recognized professionals in the area of economic development was conducted. The survey items were derived from the literature as either examples or suggestions to promote higher education involvement in economic development strategies. The item-objective congruence form addressed relevancy, currency, and overall quality of the review, including any suggestions for improvement, and should assure that all efforts to ensure content validity have been pursued (Appendix B).

The item-objective congruence form containing a three point rating scale of the 57 items and a referenced copy of

the review of the literature that generated those items were mailed to a nationwide panel of experts. These three experts were chosen on the basis of their expertise in the area of economic development and a geographical spread that sought to avoid parochialism. The data collection method consisted of having each member of the panel of experts determine the content validity of each item generated from the literature review by assigning a value of +1, 0, or -1:

> A rating of +1 indicates a definite feeling that an item is a measure of the objective; 0 shows that the judge is undecided about whether it is a measure of the objective; -1 shows a definite feeling that an item is not a measure of the objective. The content specialists' task is to make a judgement about whether or not a test item reflects the content . . . (Hambleton, 1980, p. 88)

The index of item-objective congruence considers: (1) that perfect item-objective congruence should be represented by a value of +1 and will occur when all the specialists assign a +1 to the item for the appropriate objective and a -1 to the item for all the other objectives; (2) that the worst value of the index an item can receive should be represented by a value of -1 and will occur when all the specialists assign a -1 to the item for the appropriate objective and a +1 to the item for all the other objectives; and (3) that the value of the index should not depend on the number of content specialists or the number of objectives (Hambleton, 1980, p. 89). In addition, the panel of experts was asked to comment on the following aspects of the study: (a) economic development issues omitted, and (b) suggestions

or comments that would make the study more usable and valuable (Appendix B).

Evaluation of HEEDS by Panel of Judges

A panel of judges was selected on the basis of economic development positions in academia and state/local economic development agencies (Appendix C). The panel of judges was sent a preliminary copy of HEEDS and asked to respond to the technical quality of the instrument according to these directions: Check either yes or no - Is the item clearly written and appropriate to the response scale. In addition to the preliminary instrument, each judge was provided a survey review form (Appendix C).

Also, the judges responses were used to ascertain face validation of the instrument. Face validation concerns "the extent to which an instrument looks like it measures what it is intended to measure" (Nunnally, 1970, p. 149). Patton (1982) explained as follows:

> Face validity simply means that local people can look at questionnaire items and tell what the question asks, and what the answers mean. Using their commonsensical judgement, they have reason to believe that the questions and answers are valid. (p. 153)

In addition, three open-end questions solicited the judges comments on the following aspects of HEEDS: (a) suggestions for economic development issues not included which should have been in a survey of administrators in higher education, (b) suggestions for improvement of HEEDS

directions in HEEDS, and (c) suggestions for improvement of HEEDS. Responses from the preliminary instrument and the survey review forms were used in a controlled evaluation process for refining and revising the instrument before surveying the population.

Kidder and Judd (1986) stated ". . . evaluating face validity is a subjective process, but we could calculate a validity figure by computing the amount of agreement among judges. The higher the percent who say it measures what it claims to measure, the higher the face validity" (p.55). Thus, the survey review forms served as a means of determining the technical quality of the items as well as face validity of instrument.

Reliability

An estimate of the internal consistency of the survey instrument was performed using Cronbach's coefficient alpha. Alpha is a general form of the K-R 20 formula, but unlike K-R 20 it is more suited for items that have several possible answers, each of which is given a different weight as was the case with this particular instrument (Borg & Gall, 1983, p. 285). In general, Cronbach's alpha is probably the most widely used and accepted reliability coefficient (Hull & Nie, 1979, p. 83). Furthermore, Nunnally (1970) found that alpha provided a good estimate of reliability in most situations:

> The major source of measurement error is because of the sampling content. Reliability estimates based on internal consistency actually consider sources of error that are based not, strictly speaking, on the sampling of items per se, but on the "sampling" of situational factors accompanying the administration of items. (Nunnally, 1970, p. 230)

In addition to responses from the survey review for face validation as well as for technical quality of each item, the responses from the panel of judges were examined through Cronbach's alpha methodology to provide inter-judge reliability of the instrument. Levels of alpha determined which items were deemed important variables in describing higher education involvement in economic development with respect to presently occurring activities and served as a reliability check.

Selection of the Sample and Method of Data Collection

During May, 1989, the initial mailing included a copy of HEEDS enclosed with a definition of terms, and a cover letter from Dr. Daniel G. Aldrich, Chancellor Emeritus of the University of California System (Appendix D). The letter from Dr. Aldrich confirmed the national scope and credibility of the study. Assuming a response rate would be 20% greater with follow-up than without (Bailey, 1987, p. 162), a follow-up letter, a second questionnaire and a definition of terms were sent to nonrespondents four weeks later (Appendix D). At the end of seven weeks, a final copy

of HEEDS with a definition of terms and a follow-up letter were sent requesting the nonrespondent's participation.

The researcher and major advisor agreed that the most likely respondents to higher education involvement in economic development activities would be research administrators rather than presidents of institutions. Following the results of the item-objective congruence index by the panel of experts and the item concordance by the panel of judges, a nationwide survey of research administrators at state universities and land grant institutions was conducted. The population surveyed was obtained from 1988 directories of the Council on Research Policy and Graduate Education (216), the Society of Research Administrators (102), and the United States Department of Agriculture State Extension Service Directors and Administrators (83). In addition, 19 surveys were sent to research administrators in higher education for a combined total of 420. Mailing addresses were generated by the Auburn University Economic Development Institute utilizing an A.B. DICK MAGNA SL wordprocesser. Each address was printed on labels and affixed to a 9 x 12 envelope. A printed survey questionnaire constituting a pre-addressed stamped return when folded was stuffed into each envelope along with a cover letter and a definition of terms and mailed so that it arrived at the beginning of the week for optimal response (Bailey, 1987). In addition, in order to

avoid redundancy, only personal demographic information was requested on Part I of HEEDS because each survey instrument included the institution's six digit Integrated Postsecondary Education Data System (IPEDS) identification number for future access to more comprehensive standard sources of characteristic data for comparison of differences with respect to enrollment, calendar system, library facilities, classification of institutions, etc.

Factor Analysis

Factor analysis traditionally served as an exploratory device (Harman, 1976, p. 5). Factor analysis applications in such varied fields as economics and medicine, political science and sociology, archaeology and physical science plainly illustrated that factor analysis techniques were not limited to a particular discipline (Harman, 1976). Factor analysis contributed to instrument development by conceptually validating matrices of scores from a survey instrument (Gurtin & Bailey, 1970, p. 209).

For the purpose of this study, factor analysis procedures were used to validate HEEDS in order to discover their underlying dimensionality and to discover relationships among variables (Harman, 1976; Rummel, 1970). Results of the factor analysis inferred that HEEDS does measure a range of theoretical dimensions of higher education economic development activities at state universities and land grant institutions as perceived by research administrators.

IV. DATA ANALYSIS AND RESULTS

The first part of this chapter consists of results of content validation by a panel of experts and an assessment of technical quality of the items by a panel of judges. The second section presents data analysis and results of HEEDS that contain a summary of survey returns and response rates, a review of demographic characteristics, results of a factor analysis of research administrator responses on the Presently Occurring Activity Scale, and a summary of data results.

Analysis of Data for Validation of HEEDS

The results of the index of item-objective congruence in Table 1 indicated a lack of positive agreement among the three member panel of experts on the content validity of item #26--"Advocate elimination of all faculty effort reporting associated with federal grant and contract administration." Consequently, item #26 was eliminated from the original pool of 57 items reducing the total items of HEEDS for review by the panel of judges to 56 items. Table 2 represents endorsements on the 56 items by the eight judges. The lower portion of Table 2 contains the interjudge reliability analysis. The interjudge reliability

Table 1. Item Responses of Panel of Experts and Item Acceptability for 57 Items of HEEDS

	EXPERTS				EXPERTS		
	I	II	III		I	II	III
ITEM:				ITEM:			
1	+1	+1	+1	30	+1	0	-1
2	+1	+1	+1	31	+1	+1	0
3	+1	0	+1	32	+1	+1	+1
4	+1	0	+1	33	+1	+1	-1
5	+1	+1	+1	34	+1	+1	-1
6	+1	+1	+1	35	+1	+1	-1
7	+1	0	-1	36	+1	+1	-1
8	+1	+1	-1	37	+1	+1	-1
9	+1	0	+1	38	+1	+1	+1
10	+1	+1	-1	39	+1	*	-1
11	+1	+1	-1	40	+1	+1	0
12	+1	+1	0	41	+1	+1	+1
13	+1	+1	-1	42	+1	+1	-1
14	+1	+1	-1	43	+1	+1	+1
15	+1	0	+1	44	+1	+1	+1
16	+1	0	-1	45	+1	+1	0
17	+1	0	-1	46	+1	+1	0
18	+1	+1	-1	47	+1	+1	0
19	+1	+1	+1	48	+1	+1	0
20	+1	+1	0	49	+1	+1	0
21	+1	+1	+1	50	+1	+1	0
22	+1	+1	+1	51	+1	+1	+1
23	+1	+1	0	52	+1	+1	-1
24	+1	+1	-1	53	+1	+1	+1
25	+1	+1	-1	54	+1	+1	+1
26	-1	0	-1	55	+1	+1	+1
27	+1	+1	-1	56	+1	+1	-1
28	+1	+1	-1	57	+1	+1	-1
29	+1	+1	-1				

*Missing answer

Table 2. Validity Responses of Panel of Judges and Calculation of Index of Concordance for 56 Items of HEEDS

	Judge 1	Judge 2	Judge 3	Judge 4	Judge 5	Judge 6	Judge 7	Judge 8
ITEM:								
1	0	1	0	0	0	1	1	1
2	1	1	1	1	1	1	1	1
3	0	1	1	0	1	1	1	1
4	1	1	1	1	1	1	1	1
5	1	1	1	1	1	1	1	1
6	1	1	1	0	1	1	1	1
7	0	1	1	1	1	1	1	1
8	0	1	1	1	1	1	1	1
9	1	1	1	1	1	1	1	1
10	1	1	1	1	0	1	1	1
11	1	1	1	1	1	1	1	1
12	1	0	1	0	1	1	1	1
13	1	1	1	1	1	1	1	1
14	0	0	1	1	1	1	1	1
15	0	1	1	1	1	1	1	1
16	1	0	1	1	1	1	1	1
17	0	0	1	1	1	1	1	1
18	1	0	1	1	1	1	1	1
19	1	0	1	0	1	1	1	1
20	1	1	1	1	1	1	1	1
21	1	1	1	1	1	1	1	1
22	0	1	1	0	0	1	1	1
23	0	0	1	1	1	1	1	1
24	1	0	1	1	1	1	1	1
25	1	0	1	1	1	1	1	1
26	0	0	1	1	1	1	1	1
27	1	1	1	1	1	1	1	1
28	0	1	1	1	1	1	1	1
29	1	1	1	1	1	1	1	1
30	1	0	1	0	1	1	1	1
31	1	1	1	1	1	1	1	1
32	1	1	1	1	1	1	1	1
33	1	1	1	1	1	1	1	1
34	1	1	1	1	1	1	1	1
35	1	1	1	1	1	1	1	1
36	1	1	1	1	1	1	1	1
37	1	1	1	1	1	1	1	1
38	0	1	1	0	1	1	0	1
39	0	1	1	0	1	1	1	1
40	1	1	1	1	1	1	0	1
41	1	1	1	1	1	1	1	1
42	1	1	1	1	1	1	0	1
43	1	1	1	0	1	1	1	1

Table 2. (Continued)

	Judge 1	Judge 2	Judge 3	Judge 4	Judge 5	Judge 6	Judge 7	Judge 8
ITEM:								
44	1	1	1	1	1	1	1	1
45	1	0	1	1	0	1	1	1
46	1	1	1	1	1	1	1	1
47	1	1	1	1	1	1	1	1
48	1	1	1	1	1	1	1	1
49	1	1	1	1	1	1	1	1
50	1	1	0	1	1	1	1	1
51	1	1	1	1	1	1	1	1
52	1	1	1	1	1	1	1	1
53	0	1	1	1	1	1	1	1
54	1	1	1	1	1	1	1	1
55	0	1	1	1	1	1	1	1
56	1	1	1	1	1	1	1	1

Interjudge Reliability Analysis

Source	SS	DF	MS
Items	50.84	55	.924
Within Items	34.12	392	.087
Total	84.96	447	.190

$$r = \frac{\text{MS between Items - MS within Items}}{\text{MS between Items}}$$

$$= \frac{.924 - .087}{.924}$$

$$= .9058$$

(Winer, 1971, p. 301-303)

was .90 with two judges endorsing each of the 56 items. In addition, 27 items were endorsed by all eight judges. There were 403 endorsements (90%) of a possible 448.

Summary of Survey Returns and Response Rates

Of the 420 survey instruments sent, four were undelivered and excluded from computation of the response rate for a net total instruments sent of 416 (Bailey, 1987, p. 169). In addition, four respondents refused to participate; six respondents stated that the instrument was not sent to the appropriate university system office; and ten respondents received duplicate survey instruments in the same university system office for a total of 20 incomplete survey instruments. While incomplete instruments were included in computation of the response rate, they were not included in the statistical analysis (Bailey, 1987). A total of 244 instruments were usable for statistical analysis. Based on a 416 net total instrument sent, 264 were returned for a total return rate of 64 percent. According to Babbie, a response rate of at least 60 percent was good (Babbie cited in Bailey, 1987, p. 169). Table 3 shows a summary of survey returns, and Table 4 contains response rates of all three HEEDS mailings.

Data Analysis and Results of HEEDS

Raw data from item responses were coded directly from HEEDS to dBASE III PLUS in ASCI format. The Auburn

Table 3. Summary of Survey Results

Summary of Survey Returns	N	Percent
Total instruments sent	420	100
Undelivered	4	1
Net total instruments sent	416	99
Total instruments returned	264	64
Incomplete instruments returned	20	5
Net total instruments analyzed	244	59

Table 4. Survey Response Rates

Responded To:	Percent of Sample
First mailing (week 1)	29.6
Second mailing (week 4)	18.3
Third mailing (week 7)	10.8
Incomplete instruments	4.8
Total response	63.5
No response	36.5
TOTAL	100.0

University computer facilities were used in the statistical treatment of the data.

SPSSX was used to analyze the demographic variables. There were eight different respondent demographic variables used for this study regarding respondents: (a) institutional governance, (b) position, (c) undergraduate major, (d) highest degree, (e) type institution where highest degree was obtained, (f) years of experience in present position, (g) age, and (h) gender. Demographic descriptions, frequencies, and percentages are presented in Table 5.

Of the 244 administrators who responded, 213 (87.3%) were males and 31 (12.7%) were females. The majority, 191 (78.3%) held Ph.D. degrees; 13 (5.3%) held Ed.D. degrees; and 22 (9%) held Master degrees. Respondents who held their present position for five years or less numbered 123 (50.4%); 44 (18%) held their position between 6-10 years; 25 (10.2%) held their position between 11-15 years; 16 (6.6%) held their position between 16-20 years; and 28 (11.5%) held their position for more than 20 years. Cooperative Extension/Agriculture Experimental Station Directors, numbering 61, accounted for 25%; Graduate School Deans, numbering 50, accounted for 20.5%; Vice Presidents for Research, numbering 27, accounted for 11.1%; Directors of Centers/Programs, numbering 22, accounted for 9%; and a group composed of those holding the combined position of

Table 5. Demographic Characteristics of Respondents to HEEDS with Respect to Governance, Position, Undergraduate Major, Highest Degree, Institution Where Highest Degree Was Obtained, Years of Experience, Age and Gender

	Frequency	Percentage
Governance		
Board of Trustees	130	53.3
Statewide Regents	89	36.5
Combination of Board & Regents	12	4.9
Other	13	5.3
Position		
Cooperative Extension/AES Director	61	25.0
Dean of Graduate School	50	20.5
Vice President for Research	27	11.1
Combination of Graduate School Dean and Vice President for Research	17	6.9
Director of Centers/Programs	22	9.0
Other	67	27.5
Undergraduate Major		
Liberal Arts/Pre-Professional Programs	57	23.4
Engineering/Natural Science/ Mathematics	87	35.7
Education/Education Specialist	12	4.9
Business	10	4.1
Agriculture/Forestry	29	11.9
Other	44	18.0
No Response	5	2.0
Highest Degree		
Ed.D	13	5.3
Ph.D	191	78.3
Masters	22	9.0
Bachelors	7	2.9
Other	9	3.7
No Response	2	.8

Table 5. (Continued)

	Frequency	Percentage
Type Institution Where Highest Degree Obtained		
Land Grant	130	53.3
Private	40	16.4
State University	63	25.8
Technical	4	1.6
Other	6	2.4
No Response	1	.4
Years of Experience		
Present Position:		
1 - 5 years	123	50.4
6 - 10 years	44	18.0
11 - 15 years	25	10.2
16 - 20 years	16	6.6
20 +	28	11.5
No Response	8	3.3
Age		
31 - 40	19	7.8
41 - 50	83	34.0
51 - 60	102	41.8
61 - 65	29	11.9
66 +	7	2.9
No Response	4	1.6
Gender		
Female	31	12.7
Male	213	87.3

Graduate School Dean and Vice President for Research, numbering 17, accounted for 6.9%.

Respondent age patterns indicated 19 (7.8%) were between 31-40; 83 (34%) were between 41-50; 102 (41.8%) were between 51-60; and 29 (11.9%) were between 61-65. Respondents' with undergraduate majors in the area of Engineering/Natural Science/Mathematics numbered 87 (35.7%); those in the area of Liberal Arts/Pre-Professional Programs, numbered 57 (23.4%); in the area of Agriculture/Forestry, 29 (11.9%); in the area of Education, 12 (4.9%); and those in the area of Business numbered 10 (4.1%).

Respondents who received their highest degree from land grant institutions numbered 130 (53.3%); those from state universities numbered 63 (25.8%); those from private institutions, 40 (16.4%); and those who had received their highest degree from technical schools numbered 4 (1.6%).

Respondents to HEEDS represented 140 institutions of higher education across the nation. Of the 140 institutions, land grant institution respondents represented 63 (45%) and state university respondents represented 77 (55%). One hundred and thirty (53.3%) respondents identified the predominant form of institutional governance as Board of Trustees; 89 (36.5%) as Statewide Regents; and 12 (4.9%) respondents identified a combination of the above.

Factor Analysis

HEEDS was constructed on the basis of an extensive review of the literature. The items were composed according to a theoretical assignment into five categories or dimensions that constituted what may be loosely termed "theoretical factors." The structure of those theoretical factors defined the organizational format of HEEDS. That structure is further specified according to the information in Appendix F. Reliabilities computed for the theoretical factors are reported in Appendix G.

Content analysis of responses from the panel of experts resulted in elimintion of item #26. Favorable responses by the panel of judges on item technical quality and face validation resulted in retention of the remaining 56 items of HEEDS. Factor analysis, using the SAS program, was chosen as the initial data reduction technique to determine the basic dimensionality of research administrator responses to HEEDS. Utilizing only data from the Presently Occurring Activity Scale of HEEDS, five factors emerged after initial reduction which accounted for 72.1% of the total variance (Table 6). After five factors, the eigenvalues dropped to 1.22 and 1.11 respectively. Kaiser's measure of sampling adequacy indicated an over-all MSA of .8708.

The five factor solution using Varimax and oblique PROMAX rotations were performed on the data to determine which rotation would provide a cleaner interpretation of the

data. The initial matrix was VARIMAX rotated. Orthogonality requirements were relaxed according to provisions of PROMAX rotation producing factor scores correlated according to the presentation in Table 7. PROMAX results were not investigated further because the VARIMAX results seemed more efficacious.

Table 8 presents the VARIMAX rotation of the 56 survey items with their associated factor loadings (multiplied by 100 and rounded to the nearest integer). The loadings identified with an asterisk represent items assigned to each factor. Items not loading at least $\pm$.40 on any factor were eliminated. Nine items did not meet the criterion. An explanation for an item's failure to load at $\pm$.40 was that the item did not share sufficient response variance with the variances of the retained factors. VARIMAX standardized scoring coefficients and Kaiser's MSA are reported in Appendix E. In addition, items #36 and #42 crossloaded; however, the writer determined on the basis of the oblique rotation to assign both items to Factor 5 rather than Factor 2.

Identification of HEEDS Five Factor

Each factor confirmed an underlying dimension and descriptive labels reflecting these dimensions were assigned to each factor. In factor 1 through 5, only those items loading at $\pm$.40 or greater were considered as items belonging to that factor. Factors are presented in order of

Table 6. Preliminary Eigenvalues and Percentages of Variance for Five Factors Extracted by Initial Factor Analysis on 56 Items of HEEDS

Factor	Eigenvalue	Percent of Total Variance	Cumulative Percent of Total Variance
1	15.17	43.41	43.41
2	3.77	10.80	54.21
3	2.43	6.94	61.15
4	2.25	6.44	67.59
5	1.58	4.53	72.12

Table 7. Correlations (x 100) Among the Five Factors

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
Factor 1	100				
Factor 2	32	100			
Factor 3	38	42	100		
Factor 4	18	46	29	100	
Factor 5	26	34	47	19	100

Table 8. VARIMAX Factor Loading (x 100) Pattern Matrix

Item	Factor1	Factor2	Factor3	Factor4	Factor5
1	-15	14	12	44*	28
2	-8	14	21	52*	19
3	21	28	15	35	-1
4	24	9	11	32	1
5	31	-2	-9	40*	-8
6	9	4	-8	61*	-5
7	32	14	-2	31	-18
8	26	-1	3	61*	4
9	16	7	20	43*	16
10	6	27	27	60*	15
11	5	13	31	54*	18
12	-7	20	25	54*	20
13	-17	27	17	54*	21
14	14	9	43*	19	6
15	18	27	40*	20	-5
16	22	9	50*	22	12
17	17	7	74*	19	0
18	18	18	60*	20	7
19	16	6	64*	11	8
20	5	29	45*	-2	16
21	12	28	61*	4	10
22	15	24	67*	6	8
23	61*	28	20	8	0
24	72*	13	22	3	11
25	73*	10	13	6	11
26	64*	25	12	27	-11
27	59*	34	20	27	-1
28	56*	37	10	29	-3
29	58*	26	16	18	5
30	67*	5	30	-1	34
31	76*	-2	25	-7	36
32	75*	4	17	-3	38
33	23	24	32	37	35
34	18	31	19	46*	16
35	25	25	20	11	52*
36	32	19	40*	9	39
37	43*	29	28	15	33
38	54*	26	7	11	15
39	19	32	5	20	54*
40	14	33	4	23	59*
41	14	36	4	22	40*
42	8	44*	13	29	44*
43	13	39	15	3	26
44	27	37	27	-12	23
45	29	38	28	5	15
46	26	54*	12	6	0

Table 8. (Continued)

Item	Factor1	Factor2	Factor3	Factor4	Factor5
47	13	52*	14	16	25
48	-2	61*	19	21	9
49	5	61*	10	24	34
50	6	62*	24	22	33
51	8	52*	18	-4	11
52	22	51*	5	17	13
53	24	47*	11	20	4
54	21	38	14	13	5
55	10	37	24	20	25
56	14	64*	9	12	6

VARIANCE EXPLAINED BY EACH FACTOR:

6.384	5.709	4.609	4.564	3.039

FINAL COMMUNALITY ESTIMATES:

TOTAL = 24.305

Note: (All values are multiplied by 100 and rounded to the nearest integer).

*Items contributing to naming of the factors.

their contribution to total variance. Items appear in order of decreasing factor loading.

Factor 1: Capacity Building

Factor 1 contained 12 fundamental items and was identified as Capacity Building. It contained items which dealt with the relationships of institutional infrastructure to economic development. The items most identified as Factor 1 are presented in Table 9 with associated factor loadings (multiplied by 100 and rounded to the nearest integer), variance proportion, and the reliability estimate.

Factor 2: Technology Development

Factor 2 was identified as Technology Development. The nine fundamental items in this factor were related to higher education institutional processes that could encourage technological advancement. The items most identified as Factor 2 are presented in Table 10 with the associated factor loadings, variance proportion, and the reliability estimate.

Factor 3: Research, Analysis, Evaluation

Factor 3 was labeled Research, Analysis, Evaluation. This factor consisted of nine fundamental items related to higher education economic development strategies enhanced by computer data processing. Factor 3 is presented in Table 11 with associated factor loadings, variance proportion, and the reliability estimate.

Table 9. Capacity Building

Factor Item		Pattern Loading
31	Advocate establishment of a tax deduction equal to the full market value of all industrially contributed equipment/ instrumentation	.75
32	Promote tax credit for industry-supported maintenance and servicing of donated research equipment	.75
25	Promote reducing depreciation of equipment/ instrumentation from the current 15 years to between 5 and 10 years depending upon the precise nature of the equipment/instrumentation involved	.73
24	Promote amortization of new academic facilities be reduced from the present 50 years to 20 years	.72
30	Advocate a 25% full tax credit for industrial funding of academic based research	.67
26	Encourage allocation of federally funded research grants for at least 3 to 5 years	.64
23	Advocate a facilities fund dispersed through a National Science Foundation peer review process (50/50 matching) over a 10-year period to bring academic infrastructure up to acceptable research standards	.61
27	Advocate greater flexibility of federal funding that allows investigators discretionary use of up to 10% of research monies	.59

Table 9. (Continued)

Factor Item		Pattern Loading
29	Advocate federally funded block grants that encourage multidisciplinary and regional university cooperation	.58
28	Encourage high-risk research by investigators with a proven track record	.56
38	Advocate full, portable, merit-based scholarships to the most intellectually-able 1% of entering college freshmen	.54
37	Provide mechanisms to encourage faculty assistance to small and medium size firms in export management	.43
Proportion of Total Variance		.434
Factor R^2 with all variables		.909

Table 10. Technology Development

Factor Item		Pattern Loading
56	Develop mechanisms to encourage product commercialization through patent filing, patent management, and patent licensing	.64
50	Provide knowledge transfer mechanisms that support industrial, professional and community economic development needs	.62
48	Provide a directory of institutional services that might facilitate product or process technology transfer to businesses, state/local governments, and communities	.61
49	Develop a specific program for diffusion of university technological products and processes for economic development	.61
46	Maintain a computer data base inventory of all faculty research	.54
47	Provide industries and appropriate government agencies access to relevant faculty research activities specifically for aiding economic development	.52
51	Provide a campus-wide interactive data base which includes information on faculty research activities	.52
52	Promote faculty sabbaticals in laboratory settings, e.g., industry, economic development agencies, federal laboratories	.51
53	Encourage faculty access to industrial and federal laboratories through personnel exchanges that allow laboratory scientists to teach in classrooms for one term	.43
Proportion of Total Variance		.069
Factor R^2 with all variables		.837

Table 11. Research, Analysis, Evaluation

Factor Item		Pattern Loading
17	Evaluate the institutional data base requirements of all personnel throughout the organization who need to access information for decision making	.74
22	Maintain an empirical data base for comparison and evaluation of innovation processes among university, industry, community, state and local government	.67
19	Establish guidelines to transform institutional research into a management information system	.64
21	Maintain a data base of university-industry interaction for longitudinal trend analysis	.61
18	Establish policies that reflect the needs of all personnel affected by or involved in access to information for decision making	.60
16	Maintain an MIS within the office of institutional research to diagnose problems and analyze alternatives in policy analysis, needs assessment, forecasting, impact predictions, strategic planning, economic development	.59
20	Provide cooperative extension networks with access to on-campus data bases to diagnose problems and analysis alternative economic development strategies	.45
14	Standardize data bases that can be linked for internal comparison and analysis (e.g., if data bases for academic programs and personnel were linked for a program review, an analysis of tenure density, rank distribution, and retirement probabilities are then possible)	.43
15	Collect data every academic term that includes: (a)students, (b)academic programs, (c) facilities, (d) finances, and (e) personnel	.40
Proportion of Total Variance		.108
Factor R^2 with all variables		.834

Factor 4: Human Resource Development

Factor 4 was identified as Human Resource Development. All fundamental items in this factor dealt with higher education economic development policies and programs designed to enhance human resources. Table 12 presents the eleven fundamental items contained in Factor 3 plus the relevant factor loadings, variance proportion, and the reliability estimate.

Factor 5: New Business Development

Factor 5 was labeled New Business Development. All fundamental items in this factor dealt with higher education economic development mechanisms to aid entrepreneurs in new business enterprises. Factor 5 contained five items meeting the loading criteria. These items are presented in Table 13 with the associated factor loadings, variance proportion, and the reliability estimate.

Data Interpretation Results

In order to ascertain the relationships among research administrator responses to HEEDS and the demographic variables included in this study, multivariate analysis of variance for institutional governance, and respondents' undergraduate major area, highest degree obtained, type of institution where highest degree obtained, and position were computed using the SAS MANOVA routine (Tables 14-18). If a

Table 12. Human Resource Development

Factor Item		Pattern Loading
6	Promote international studies that enhance knowledge of other cultures as a core requirement for undergraduate curricula	.61
8	Encourage undergraduate interdepartmental studies	.61
10	Encourage academic policy that requires multidisciplinary graduate study within the framework of traditional departments	.60
11	Establish advisory councils and other linkage mechanisms to keep in touch with community needs	.54
12	Build capacity to address economic development priorities through symposia and conferences involving diverse community groups including business, labor, and local government leaders and faculty	.54
13	Educate policy makers and the general public about university resources that could promote local economic development	.54
2	Offer appropriate instruction at flexible times to meet the unique needs of industry, community, and state/local government in planning for economic development	.52
34	Develop centers for excellence that focus on existing service areas in which the institution has expertise	.46
1	Recognize public service contributions that promote economic development activities in an instructional reward system in addition to the traditional scholarly engagements	.44
9	Devise instructional methodologies across curricula that utilize case studies in combination with problem-solving simulations	.43
5	Promote an undergraduate foreign language requirement	.40
Proportion of Total Variance		.064
Factor R^2 with all variables		.838

Table 13. New Business Development

Factor Item		Pattern Loading
40	Provide entrepreneurial assistance programs with emphasis on new business development, i.e., evaluation of technical feasibility, market evaluation, production costs, financial viability, and general business and management advice	.59
39	Provide management and technical assistance to potential entrepreneurs	.54
35	Develop linkage mechanisms between venture capital networks and entrepreneurs	.52
42	Develop mechanisms that stimulate new business development, e.g., incubators, research centers, entrepreneurial training programs, and innovation centers	.44
41	Provide industrial extension agents who will work specifically with new and small businesses in market identification, management training, computer use, exporting, procurement assistance, patent and licensing arrangements	.40
36	Develop research strategies that monitor potential foreign markets for state industries	.40
Proportion of Total Variance		.045
Factor R^2 with all variables		.781

Table 14. MANOVA of Factor Scores with Selected Main Effects: DEGREE

MANOVA Test Criteria for the Hypothesis of No Overall DEGREE Effect

H = TYPE III SS&CP MATRIX FOR: DEGREE		
P = RANK OF (H+E)	=	5
Q = HYPOTHESIS DF	=	4
NE= DF OF E	=	124
S = MIN(P,Q)	=	4
M = .5(ABS(P-Q)-1)	=	0.0
N = .5(NE-P)	=	59.5

WILKS' CRITERION	L = DET(E)/DET(H+E) =	0.83122740
W = -(NE-.5(P-Q+1))*(LN(L)	=	22.7368
U = NE-.5(P-Q+1)	=	123.0000
Z = SQRT((P*P*Q*Q-4)/(P*P*Q*Q-5)	=	3.3166
B = (P*Q-2)/4	=	4.5000

F APPROXIMATION = (U*Z-2B)/(P*Q)*(1-L**1/Z)/L**1/Z
WITH P*Q AND U*Z-2B DF

F(20,398.94) = 1.14 PROB > F = 0.3021

Table 15. MANOVA of Factor Scores with Selected Main Effects: UNDERGRADUATE MAJOR

MANOVA Test Criteria for the Hypothesis of No Overall UNDERGRADUATE MAJOR Effect

H = TYPE III SS&CP MATRIX FOR:	UNDERGRADUATE MAJOR	
P = RANK OF (H+E)	=	5
Q = HYPOTHESIS DF	=	5
NE= DF OF E	=	124
S = MIN(P,Q)	=	5
M = .5(ABS(P-Q)-1)	=	-0.5
N = .5(NE-P)	=	59.5

WILKS' CRITERION	L = DET(E)/DET(H+E) =	0.78302850
W = -(NE-.5(P-Q+1))*(LN(L)	=	30.2064
U = NE-.5(P-Q+1)	=	123.5000
Z = SQRT((P*P*Q*Q-4)/(P*P*Q*Q-5)	=	3.7148
B = (P*Q-2)/4	=	5.7500

F APPROXIMATION = (U*Z-2B)/(P*Q)*(1-L**1/Z)/L**1/Z
WITH P*Q AND U*Z-2B DF

F(25,447.28) = 1.22 PROB > F = 0.2169

Table 16. MANOVA of Factor Scores with Selected Main Effects: SCHTYPE

MANOVA Test Criteria for the Hypothesis of No Overall SCHTYPE Effect

H = TYPE III SS&CP MATRIX FOR: SCHTYPE		
P = RANK OF (H+E)	=	5
Q = HYPOTHESIS DF	=	8
NE= DF OF E	=	124
S = MIN(P,Q)	=	5
M = .5(ABS(P-Q)-1)	=	1.0
N = .5(NE-P)	=	59.5

WILKS' CRITERION	L = DET(E)/DET(H+E) =	0.74389986
W = -(NE-.5(P-Q+1))*(LN(L)	=	36.9811
U = NE-.5(P-Q+1)	=	125.0000
Z = SQRT((P*P*Q*Q-4)/(P*P*Q*Q-5)	=	4.3589
B = (P*Q-2)/4	=	9.5000

F APPROXIMATION = (U*Z-2B)/(P*Q)*(1-L**1/Z)/L**1/Z
WITH P*Q AND U*Z-2B DF

F(40,525.86) = 0.92 PROB > F = 0.6076

Table 17. MANOVA of Factor Scores with Selected Main Effects: GOVERNANCE

MANOVA Test Criteria for the Hypothesis of No Overall GOVERNANCE Effect

H = TYPE III SS&CP MATRIX FOR: GOVERNANCE		
P = RANK OF (H+E)	=	5
Q = HYPOTHESIS DF	=	4
NE= DF OF E	=	124
S = MIN(P,Q)	=	4
M = .5(ABS(P-Q)-1)	=	0.0
N = .5(NE-P)	=	59.5

WILKS' CRITERION	L = DET(E)/DET(H+E) =	0.83845342
W = -(NE-.5(P-Q+1))*(LN(L)	=	21.6721
U = NE-.5(P-Q+1)	=	123.0000
Z = SQRT((P*P*Q*Q-4)/(P*P*Q*Q-5)	=	3.3166
B = (P*Q-2)/4	=	4.5000

F APPROXIMATION = (U*Z-2B)/(P*Q)*(1-L**1/Z)/L**1/Z
WITH P*Q AND U*Z-2B DF

F(20,398.94) = 1.09 PROB > F = 0.3588

Table 18. MANOOVA of Factor Scores with Selected Main Effeects: POSITION

MANOVA Test Crriteria for the Hypothesis of No Overall POSITION Effectt

H == TYPE III SS&CP MATRIX FOR: POSITION		
P == RANK OF (H+E)	=	5
Q == HYPOTHESIS DF	=	22
NE== DF OF E	=	124
S == MIN(P,Q)	=	5
M == .5(ABS(P-Q)-1)	=	8.0
N == .5(NE-P)	=	59.5

WILKS' CRITERION	L = DET(E)/DET(H+E) =	0.42092926
W = --(NE-.5(P-Q+1))*(LN(L)	=	114.2183
U = NNE-.5(P-Q+1)	=	132.0000
Z = SSQRT((P*P*Q*Q-4)/(P*P*Q*Q-5)	=	4.8990
B = ((P*Q-2)/4	=	27.0000

F APPPROXIMATION = (U*Z-2B)/(P*Q)*(1-L**1/Z)/L**1/Z
WITH P*Q AND U*Z-2B DF

F((110,592.67) = 1.04 PROB > F = 0.3793

respondent had missing data on any item, it was eliminated from the analysis; thus, 61 of 244 observations were omitted from the analysis. The .05 level of significance was established for all analyses. The independent variables did not explain the observed variance in the five factor scores suggesting that there was as much heterogeneity within groups as in the complete sample.

V. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

This study was primarily concerned with developing and validating an instrument which would measure current economic development activities as perceived by research administrators at state universities and land grant institutions. While the instruments' response scale differentiated between those economic development activities presently occurring and those activities that should be occurring in higher education, the conclusions reported in this study are based solely on the responses to the presently occurring portion of HEEDS.

Four research questions provided a framework for interpreting the resulting data:

1. What are the general dimensions (factors) of the instrument as reflected in data collected from the sample of research administrators?

2. What is the reliability of the instrument?

3. What evidence may be presented for the instrument to establish its content validity?

4. Do the underlying factor dimensions of the instrument reflect the theoretical dimensions underlying its construction?

By 1973, the current higher education economic development connection began in earnest (Bernstein, 1986). Historically, state initiatives to attract new industry had resolved around tax incentives and state/local subsidies (Morrison, 1986), but by the early 1980s that policy had evolved into community economic development efforts to improve the infrastructure in order to attract new industry (Malecki, 1987). Among the major results of this study in determining the items for factor analysis was a comprehensive review of the literature that identified five theoretical dimensions of higher education economic development. In addition, since there was limited empirical studies available, the major contribution of this study was not only a validation of the instrument items that provided a methodology, but also a thorough research and evaluation of the literature that will add significantly to the data base.

Results of this study indicated (a) a need for reevaluation of higher education faculty tenure, promotion, and service project policies to emphasize diffusion of research; (b) an increase in global economic development initiatives by local government and state agencies; (c) a trend toward states in a particular geographical area organizing under the auspices of a regional umbrella to analyze and evaluate existing common strengths, to coordinate interstate economic development policies that

enhance those strengths, and to promote key niche areas based on those strengths in the development of new markets; (d) an increase in the prominence of land grant institutions as a successful role model in providing industrial cooperative extension efforts and in providing convenient, lifelong, continuing adult education; (e) the most successful occurrence of knowledge transfer occurred through personal contacts by field agents familiar with the problems of business who utilized problem-solving techniques and simulations; (f) the most successful field agents were aggressive risk-takers who were willing to make informed judgments on technical and business issues and to commit resources in situations where successful outcomes could not be predicted; (g) a need for more one-on-one technical assistance to small- and medium-sized firms which do not have broad technical and research capabilities, particularly in utilizing off-the-shelf software, i.e., spreadsheets and data base for expediting exports; (h) a few successful cases produced most of the benefits while the majority of cases produced little or no benefit which is typical of activities involving innovation; (i) the overwhelming need for a comparative data base to serve as a clearinghouse for regional and state/local organizations to analyze and evaluate economic development activities, and (j) a national policy that will offer incentives to move the regional restructuring forward by coordinating rather than dictating

diffusion of innovation. Increasingly, a key player in state economic development initiatives was postsecondary institutions (AASCU, 1986a).

From the review of the literature, seven economic development objectives were reduced to five which included: human resource development; research, analysis, and evaluation; capacity building; new business development; and technology development. First, human resource development has undergone significant demographic changes that have altered the conventional academic wisdom and reinforced a number of basic factors regarding convenient, lifelong, continuing adult education with respect to format, location, and timing of instruction (Hodgkinson, 1985; Lynton & Elman, 1987; Moos, 1981; WHSC, 1986). Of all the roles of higher education's involvement in economic development, human resource development was listed as the most important (AASCU, 1986a). Other studies suggested that modern universities must become more flexible in adapting to the world outside academia with regard to developing the external (students) and internal (faculty/staff) potential of its human resources (Lynton & Elman, 1987; NASULGC, 1985). For example, a more flexible academic response towards human resources should include: curriculum review and development that effectively prepares students to cope with a global economy (AASCU, 1986a); improvement of outmoded pedagogic methodologies that enable students to

become effective problem solvers (Choate & Linger, 1986); and an overall innovative institutional mission response to its public service, teaching, and research responsibilities (NEBHE, 1987; Osborne, 1987; WHSC, 1986). Essentially, the traditional human resource development role of academia has made it an ideal capacity building mechanism for a wide range of university sponsored programs such as technology development, new business development, and research, analysis and evaluation activities.

Second, information management demanded adequate data bases that could be linked for analysis and leadership competent to evaluate and act upon that information (Jonsen, 1986; Moos, 1981). One of the most consistent problems of higher education in economic development remained their collective inability to utilize adequately a data base that allows decision makers to effectively manage technological resources (Byron, 1984; Cope, 1981; Keller, 1983; Klingman & Phillips, 1988). A data base that would allow decision makers an opportunity to make comparisons and evaluations regarding: strategic planning (Cope, 1986; Jonsen, 1986; Keller, 1983); higher education and state economic development activities (Beachler, 1985; Bernstein, 1986; Siegel, 1988); university-industry interaction (Melchiori, 1984; NSF, 1982; Stankiewicz, 1986); and empirical research of university innovation initiatives with businesses, state and local governments, and communities (Gray, Solomon, &

Hetzner, 1986; Gray, Johnson, and Gidley, 1987; Solomon & Tornatsky, 1986; Tornatsky, 1983). Thus, if higher education is to develop a pivotal role in the emerging economic development triad of university, industry, and government interaction, then an adequate analysis over time demands an empirical data base for future comparison and evaluation.

Third, in order to maximize capital resources required not only efficient coordination of human resources and the involvement of entrepreneurs in developing new legal, social, and economic infrastructures to serve new markets (John, 1987; Osborne, 1987), but also a comprehensive agenda to address the rebuilding of America's public works infrastructure. While the nation's public works infrastructure has been deemed insufficient to meet future economic development demands (Laing, 1988; Szabo, 1989), its deterioration was rivaled by that of higher education classrooms and scientific equipment (Bloch, 1986; Matthews & Norgaard, 1984). Such an impact could seriously diminish the capacity to compete globally in science and engineering where economic growth required technological innovation (Choate & Linger, 1986; Doyle & Brisson, 1985; Peters and Fusfeld, 1983; Osborne, 1987; WHSC, 1986). HEEDS addressed specific capacity building activities aimed at expanding human resource development services; promoting accurate information shared through academic, state/local government,

labor, business, and community networks; and promoting an innovative climate conducive to achieve optimal growth in new business and technology development.

Fourth, initiatives to aid existing industry often played a key role in enhancing the overall quality of business climate and thereby became an important factor in attracting new businesses (Clarke, 1986; John, 1987). John (1987) referred to a 1985 SBA study that found individual entrepreneurs in small or new businesses were an especially productive source of innovation. University incubator facilities were used to support new, small businesses by providing low-rent office and lab space (Clarke, 1986). Additional on-site support services, computer access, and management/technical services were offered on a referral basis as needed (Watkins & Wills, 1986). Creative financial arrangements have allowed universities to benefit financially from involvement in new business development through financing spin-offs with seed money; using faculty consulting services, office space, and laboratory equipment in return for royalties from patent rights, licensing arrangements, as well as rent and equity interest (Chmura, 1987; Clarke, 1986; Watkins, 1985a). Moreover, higher education participation and financial involvement in the creation of new businesses has attracted the advanced technology sector, in particular, thereby creating

additional academic science and technology capacity for economic development (Peters & Fusfeld, 1983).

Fifth, the role of higher education in technology development has occurred primarily in the transfer of basic research and technical assistance (Peters & Fusfeld, 1983). While the major role of university knowledge transfer traditionally took place in the classroom, today its role has expanded to include the following: development, coordination, communication, needs assessment, integration, and cooperation of industry, state/local government, labor, and community groups (Swanson, 1986). Although differences between academic and industry research goals often have been a source of contention because of their resultant research approaches (GUIR, 1986; Lynton & Elman, 1987; Matthews & Norgaard, 1984; Peters & Fusfeld, 1983), additional studies found personnel exchanges and other examples of university-industry interaction conducive for mutual understanding among all parties (AASCU, 1986a; Doyle & Brisson, 1985). In fact, Doyle and Brisson (1985) found that mutual understanding and clarification on a one-to-one basis were essential before beginning any research project. Further, the fundamental problems in economic development are not technological in nature, rather they stemmed from political, economic, and social constraints to innovate (London, 1988). Elimination of these constraints to innovate usually came about as a result of the influence of an individual in the

role of a champion (Matthews & Norgaard, 1984), or an entrepreneurial risk taker who established vital links between conflicting public and private sectors (NSF, 1982; Peters & Fusfeld, 1983).

By 1986, higher education became a critical player in establishing linkages between the public and private sector (Bernstein, 1986) and has been responsible for providing an objective forum for public policy debates to reduce structural constraints, setting a tone for establishing a climate conducive to innovation (John, 1987).

The purpose of this study was to develop and validate a survey instrument measuring responses from research administrators at state universities and land grant institutions of current economic development involvement. Since no suitable standardized instrument existed for empirically measuring the frequency of these activities, HEEDS was constructed according to the following steps: (a) identify areas that facilitate higher education-economic development involvement, (b) develop items to measure that involvement, (c) establish content validity of items, (d) establish technical quality of items, (e) identify the population for which the instrument was intended, (f) identify the appropriate methodological approach to obtain data, and (g) develop an instrument format that was easy to read and to answer and that gave results easy to tabulate.

Conclusions

Based on the data from the sample of 244 in this study, the following conclusions were reached:

1. HEEDS did successfully reflect the theoretical dimensions underlying its construction.

2. The five factors which emerged from the factor analysis confirmed the majority of items as reflected in the literature review, content analysis by a panel of experts, and a technical review of the items by a panel of judges.

Recommendations

The findings of the current investigation served as a basis for the following possible uses of HEEDS:

1. The validation of HEEDS provides useful and enlightening empirical knowledge that confirms five dimensions of economic development in higher education. It is recommended that higher education administrators use this instrument in assessing their institutions' unique economic development strategies.

2. Decision makers should use HEEDS along with other comparative and referential data to formulate policy for integrating functions of university centers and institutes emerging on campuses throughout America.

3. The validation of the five dimensions of HEEDS could be useful to state legislators in allocating limited financial resources for education. It is recommended that existing service areas in which a particular institution

excels could be examined in light of the five dimensions of HEEDS. In this way, unnecessary, costly, or redundant programs could be eliminated or integrated and new areas of opportunity could be initiated.

4. It is recommended that HEEDS be used as a tool for further research. The instrument could enable researchers to investigate the reasons that administrators responded as they did about perceived and normative economic development activities.

5. Future studies replicating the procedures developed for this study should provide opportunities for refinement of HEEDS.

6. Although there is a clear fit of five factors to the data collected from the current sample of 244 representing the dimensionality of HEEDS, the MANOVA did not produce systematic differences among groups of respondents broken down according to specifications of the model tested. Further modeling is recommended based on demographic and other variables not collected for this study.

7. Researchers should utilize this research and future research to develop operational models for sharing information and improving the possibilities for other successful relationships among academic, state/local government, labor, business, and community networks.

8. Further studies utilizing case study methodology should explore the five dimensions of higher education

economic development to support or refute the procedures used to validate HEEDS.

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APPENDICES

APPENDIX A

MAGNITUDE ESTIMATIONS OF EXPRESSIONS OF FREQUENCY AND AMOUNT USED IN HEEDS

Magnitude Estimations of Expressions of Frequency and Amount

Steven's (1966) procedures seemed to be a more accurate way of magnitude estimations of standardizing expressions of frequency and amount. According to Steven's (1971) law that equal stimulus ratios produce equal sensations, objective quantities of frequency and amount could be readily associated with subjective modifiers. Based on Steven's law, Bass (1968) initiated an objective procedure of standardizing expressions for a questionnaire survey. The frequency scale he used was based on a magnitude estimation study of 28 adverbs of frequency. Each of 71 undergraduate students had been asked to assign a number of his own choosing to "sometimes," then to indicate what number would best fit each of the 28 other adverbs. On the average, if "sometimes" was set at 1.000, "always" was seen as 2.533 times as frequent; "very often" was 2.093 times as frequent; "fairly often" was 1.683 times as frequent; "seldom" was .425 times as frequent; and "never" was .000. Of the 28 adverbs studied, these particular 6 bore an approximate relation to each other of 5:4:3:2:1:0 and were selected as the response alternatives for a questionnaire (Bass et al., 1974).

APPENDIX B

CONTENT VALIDATION OF THE LITERATURE REVIEW

List of Panel of Experts

Dr. Daniel G. Aldrich, Jr.
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Irvine, CA 92717

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New England Board of Higher Education
45 Temple Place
Boston, MA 02111

Dr. Roy Marlowe
Director of PENNTAP
Penn State University
101 George building
306 West College Avenue
University Park, PA 16801

Auburn University
Auburn University, Alabama 36849-5112

Office of the Vice President for Research
202 Samford Hall

Telephone (205) 826-4784
ATTNet: 221-4784

March 2, 1989

Mr. ///

Dear ///

Thank you for agreeing to serve as a member of an expert panel to evaluate the review of the literature which I have conducted for this research with the Economic Development Institute. An item-objective congruence form and a copy of Chapter 2 to be used as a reference are enclosed. Upon completion of the evaluation, return the form and keep the complementary Chapter 2 for your files. Also, I will be pleased to provide a final copy of the study upon request.

As we discussed by telephone, the purpose of this study is to develop and validate a survey instrument to measure the frequency of presently occurring state university and land grant institution activities in economic development. A review of the literature generated survey items that were intended to have content validity. The review of the literature covered two areas: (a) historical overview of state universities and land grant institutions and their role in economic development, and (b) emerging roles of higher education in state economic development strategies. Sources included books, journals, and a variety of references from data banks, such as DIALOG Information Retrieval Service, ERIC, National Technical Information Service (NTIS), Public Affairs Information Service (PAIS), and the Dissertation Abstracts International.

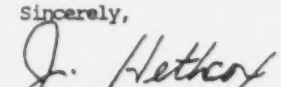
The item-objective congruence form is comprised of two parts. Part 1 contains a three point rating scale to evaluate the content validity of each item and Part 2 asks for suggestions or comments to improve on relevancy, currency, and overall quality of the review.

If possible, I would appreciate receiving your response by March 27, 1989. I have enclosed a self-addressed envelope with first class postage for your convenience.

Should you need to talk with me about the evaluation, I can be reached most days at (205) 826-4704 between 8:00 a.m. and 5:00 p.m. and most evenings at (205) 245-7537 between 7:00 p.m. and 10:00 p.m. Please feel free to call collect.

I appreciate your willingness to help me complete this research activity.

Sincerely,



Jim Hethcox
Doctoral Candidate
Economic Development Institute
3354 Haley Center
Auburn University, AL 36849-5252

/kd

Enclosures: Item-Objective Congruence Form
Chapter 2

NEW ENGLAND BOARD OF HIGHER EDUCATION

Office of the President

March 17, 1989

Jim Hethcox
Doctoral Candidate
Economic Development Institute
3354 Haley Center
Auburn University
Auburn University, AL 36849

Dear Jim:

Trust the enclosed completed form is responsive.

I was struck by how inadequate dissemination of NEBHE's decade of work remains. I therefore have enclosed several items which I believe you will find of particular interest and I anticipate worthy of citation:

Business and Academia: Partners in New England's Economic Renewal
New England's Vital Resource: The Labor Force
Financing Higher Education: The Public Investment

Also, you may find the two shorter pieces from the New England Journal of Public Policy and The Massachusetts Miracle, MIT Press, of interest as well.

Here in the region, these references have been used, quoted and reprinted by our media and higher education community.

Also, A Threat to Excellence, which is the benchwork regional public policy document published by NEBHE's Commission on Higher Education and the Economy of New England preceeded by a full year A Nation at Risk, and the more than 200 Commission Reports on Education and Competitiveness issued by national, association and state groups.

I found the Chapter gracefully written. The degree to which it is possible to be comprehensive as well as intelligible remains the great mystery of useful doctoral dissertations. You have done admirably.

With best regards.

Sincerely yours,

John C. Hoy
President

JCH/dh
Enclosures
5319C

45 TEMPLE PLACE, BOSTON, MASSACHUSETTS 02111 (617) 357-9620

Since 1965

(814) 865-0427

Pennsylvania Technical Assistance Program

501 J.O. Keller Building University Park, Pennsylvania 16802

March 23, 1989

Mr. Jim Hethcox
Economic Development Institute
3354 Haley Center
Alburn University
Alburn, Alabama 36849-5112

Dear Jim:

As requested in your letter of March 2, 1989, I have read with interest your second chapter, Review of the Literature and completed the Item-Objective Congruence Form.

I must confess that because of my interest or for some other reason, I had difficulty separating the ideas in the item from the dimension. Therefore, I filled out the form by limiting my answers strictly to the proceeding paragraph or paragraghs and did not include it if it merely mentions the concept. I counted it only if it made a specific reference. If this interpretation is too restrictive please let me know and I will do it again.

In addition to my comments on the separate comment sheet which was received from Keri Dubbenley, I would offer you two suggestions. If you haven't already done so, you may want to contact Dr. Robert Chapman at the National Institute for Standards and Technology and request a copy of his study that he has just completed for Congress. His study is to determine what industrial extension programs are operating in the fifty states that have an impact on economic development.

I know that Chapter 2 is a reviewed literature without imput from you. You may not want to contradict your sources but I think an error appears on Page 45. My recollection of the State Technical Services had every state agreeing to cooperate and I have enclosed a 1967 list of the state designated agencies. If my memory serves me correct, every state had an active program except Mississippi.

Also with the literature search if you haven't done so you may want to contact the National Governors Association. This is a good place to learn about economic development that is being done. Many activities are so new that they have not yet appeared in the literature.

PENNTAP is administered by The Pennsylvania State University in partnership with and partial support from the Pennsylvania Department of Commerce to disseminate new technologies to industrial and public sectors

MEMBER National Association of Management and Technical Assistance Centers (NAMTAC)
Technology Transfer Society (T2S)
National Productivity Network (NPN)

Mr. Hethcox
Page 2
March 23, 1989

As I said previously, I do not feel very confident about my response to your questionnaire. If you have any questions or if I can help in any other way, please don't hesitate to let me know. Obviously, I would like to receive a copy of the report when it is completed. Good luck!

Sincerely,

H. LeRoy Marlow
Director

Please comment or offer suggestions to the following aspects of the study:

1. Economic development issues ommitted are

Everyone today is discussing economic development but it means many things to many people. Do you in your opening chapter intend to limit what you mean by economic development or will you leave it extremely broad? It seems to me that everybody today is justifying the existence of their program or activity in terms of having a positive economic impact. The programs run the gamut from illiteracy training to real estate development to governmental regulations to technology transfer.

2. Suggestions or comments that you feel would make this study more usable and valuable for professional economic developers are

Many persons who are actively engaged in providing assistance in economic development will not have the time or inclination to read a long detailed study. They will accept your research methodology and your conclusions since you will be the most knowledgeable person at the moment on this topic. Therefore, I would suggest that you strongly consider providing a summary with key recommendations set forth early in the report. Then you can use the main body of your research as a "appendix" or to justify your conclusions for those willing to do the detailed analysis.

ITEM-OBJECTIVE CONGRUENCE

Reviewer: _____ Date: _____

First, read carefully the review of the literature on higher education and economic development. Next, please indicate how well you think each item reflects the dimension it measures. The page following each item references where the item emerged from the literature review. Please use the three-point rating scale to indicate the following:

+1 indicates a definite feeling that an item is a measure of the dimension

0 indicates indecision about whether the item is a measure of the dimension

-1 indicates a definite feeling that the item is not a measure of the dimension

	ITEMS	RATINGS
Human Resource Development (Dimension I)		
1.	Recognize public service contributions that promote economic development activities in an instructional reward system in addition to the traditional scholarly engagements (see page 49).	+1 0 -1
2.	Offer appropriate instruction at flexible times to meet the unique industry, community, and state/local government in planning for economic development (see page 50).	+1 0 -1
3.	Utilize advanced telecommunication delivery systems that beam instruction from campus via satellite uplink to the consumer (see page 50).	+1 0 -1
4.	Provide a pre-school program for families of faculty, staff, and students (see page 52).	+1 0 -1
5.	Promote an undergraduate foreign language requirement (see page 52).	+1 0 -1
6.	Promote international sutdies as a core requirement for undergraduate curricular that enhances knowledge of other cultures (see page 52).	+1 0 -1
7.	Conduct a junior year abroad foreign exchange program (see page 52).	+1 0 -1
8.	Provide policies that encourage undergraduate interdepartmental studies (see page 55).	+1 0 -1
9.	Devise instructional methodologies across curricula that utilize case studies in combination with problem-solving simulations (see page 55).	+1 0 -1
10.	Encourage academic policy that requires multidisciplinary graduate study within the framework of traditional departments (see page 56).	+1 0 -1
11.	Establish advisory councils and other linkage mechanisms to keep in touch with community needs (see page 57).	+1 0 -1

12. Build capacity through symposia and conferences involving diverse community groups including business, labor, and local government leaders and faculty to address economic development priorities (see page 57). +1 0 -1

13. Educate policy makers and the general public about university resources that could promote local economic development (see page 57). +1 0 -1

Research, Analysis, Evaluation (Dimension II)

14. Standardize data bases that can be linked for internal comparison and analysis (e.g., if data bases for academic programs and personnel were linked for a program review, an analysis of tenure density, rank distribution, and retirement probabilities are then possible) (see page 59). +1 0 -1

15. Collect data every term that minimally includes: (a) students, (b) academic programs, (c) facilities, (d) finances, and (e) personnel (see page 59). +1 0 -1

16. Maintain an MIS within the office of institutional research to diagnose problems and analyze alternatives in policy analysis, needs assessment, forecasting, impact predictions, strategic planning, economic development (see page 60). +1 0 -1

17. Evaluate the institutional data base requirements of all personnel throughout the organization who may need to access information for decision making (see page 61). +1 0 -1

18. Establish policies that reflect the needs of all personnel affected by or involved in access to information for decision making (see page 61). +1 0 -1

19. Establish guidelines to transform institutional research into a management information system (see page 62). +1 0 -1

20. Provide cooperative extension networks with access to on-campus data bases to diagnose problems and analyze alternative economic development strategies (see page 62). +1 0 -1

21. Maintain a data base of university-industry interaction for longitudinal trend analysis (see page 63). +1 0 -1

22. Maintain an empirical data base for comparison and evaluation of innovation processes between university, industry, community, state and local government interactions (see page 64). +1 0 -1

Capacity Building (Dimension III)

23. Advocate a facilities fund dispersed through a National Science Foundation peer review process (50/50 matching) over a 10-year period to bring academic infrastructure up to acceptable research standards (see page 66). +1 0 -1

24. Promote amortization of new academic facilities be reduced from the present 50 years to 20 years (see page 67). +1 0 -1

25. Promote reducing depreciation of equipment/instrumentation from the current 15 years to between 5 and 10 years depending upon the precise nature of the equipment/instrumentation involved (see page 67). +1 0 -1

26.	Advocate elimination of all faculty effort reporting associated with federal grant and contract administration (see page 67).	+1 0 -1
27.	Encourage federally funded research grants be allocated for at least 3 years and preferably 5 years (see page 67).	+1 0 -1
28.	Advocate greater flexibility of federal funding that allows investigators discretionary use of up to 10% of research monies (see page 67).	+1 0 -1
29.	Encourage high-risk research of investigators with a proven track record (see page 67).	+1 0 -1
30.	Advocate federally funded block grants that encourage multi-disciplinary and regional university cooperation (see page 67).	+1 0 -1
31.	Advocate a 25% full tax credit for industrial funding of academic based research (see page 68).	+1 0 -1
32.	Advocate establishment of a tax deduction equal to the full market value of all industrially contributed equipment/instrumentation (see page 68).	+1 0 -1
33.	Promote tax credit for industry-supported maintenance and servicing of donated research equipment (see page 68).	+1 0 -1
34.	Establish advisory councils and other linkage mechanisms to keep abreast of the needs of the service area (see page 69).	+1 0 -1
35.	Develop centers for excellence that focus on existing service areas in which the institution has expertise (see page 69).	+1 0 -1
36.	Develop linkage mechanisms between venture capital networks and entrepreneurs (see page 70).	+1 0 -1
37.	Develop research strategies that monitor potential foreign markets for state industries (see page 70).	+1 0 -1
38.	Provide mechanisms to encourage faculty assistance to small and medium size firms in export management (see page 70).	+1 0 -1
39.	Advocate full portable, merit-based scholarships to most intellectually-able 1% of entering college freshmen (see page 71).	+1 0 -1
New Business Development (Dimension IV)		
40.	Provide management and technical assistance to potential entrepreneurs including faculty (see page 73).	+1 0 -1
41.	Provide entrepreneurial assistance programs with emphasis on new business development, i.e., evaluation of technical feasibility, market evaluation, production costs, financial viability, and general business and management advice (see page 74).	+1 0 -1
42.	Provide industrial extension agents who will work specifically with new and small businesses, e.g., market identification, management training, computer use, exporting, procurement assistance, patent and licensing arrangements (see page 74).	+1 0 -1

43. Develop mechanisms that stimulate new business development, e.g., incubators, research centers, entrepreneurial training programs, and innovation centers (see page 78). +1 0 -1

44. Negotiate prior to actual involvement, expected financial benefits (i.e., royalties, rents, equity ownership) in return for institutional seed money, use of faculty consulting services, office space, and laboratory equipment (see page 78). +1 0 -1

45. Set measurable goals for data analyses and evaluation of institutional programs promoting new business for economic development (see page 79). +1 0 -1

Technology Development (Dimension V)

46. Develop organizational mechanisms for synthesizing faculty research for data processing (see page 82). +1 0 -1

47. Maintain a computer data base inventory of all faculty research (see page 82). +1 0 -1

48. Provide industries and appropriate government agencies access to relevant faculty research activities specifically for aiding economic development (see page 82). +1 0 -1

49. Provide a directory of institutional services that might facilitate product or process technology transfer to businesses, state/local governments, and communities (see page 82). +1 0 -1

50. Develop a specific program for diffusion of university technological products and processes for economic development (see page 84). +1 0 -1

51. Provide knowledge transfer mechanisms that support industrial professional and community economic development needs (see page 84). +1 0 -1

52. Provide a campus-wide interactive data base which includes information on faculty research activities (see page 84). +1 0 -1

53. Promote faculty sabbaticals in laboratory settings, e.g., industry, economic development agencies, federal laboratories (see page 85). +1 0 -1

54. Encourages faculty access to industrial and federal laboratories in personnel exchanges that also allow laboratory scientists to teach in classrooms for one term (see page 84). +1 0 -1

55. Establish specific institutional guidelines for faculty consulting regarding conflicts of interest and academic freedom (see page 85). +1 0 -1

56. Provide equitable compensation for faculty consulting and reward public service contributions that contribute to economic development (see page 85). +1 0 -1

57. Develop mechanisms to facilitate product commercialization through patent filing, patent management, and patent licensing (see page 85). +1 0 -1

Please comment or offer suggestions to the following aspects of the study:

1. Economic development issues ommitted are _____

2. Suggestions or comments that you feel would make this study more usable and valuable for professional economic developers are _____

APPENDIX C

TECHNICAL ITEM REVIEW FORM

AND COVER LETTER

List of Panel of Judges

Mr. Richard W. Compton
Deputy Regional Administrator
U.S. Department of Housing Urban Development
75 Spring Street, SW
Atlanta, GA 30303

Mr. Bob Davis
P. O. Box 201
Fort Deposit, AL 36032

Mr. Richard England
Staff Associate for Research and Services
Alabama Commission on Higher Education
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Mr. John W. Floyd
Executive Vice-President
17 West Fort Williams Street
Sylacauga, AL 35150

Mr. Bob Lunsford
Manager, Department of Housing
and Urban Development
15 South 20th Street
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Dr. Warren McCord
State Leader, Community Resource Development
Alabama Cooperative Extension Service
203 Duncan Hall
Auburn University, AL 36849

Dr. Munsell McPhillips
Science, Technology and Energy Division
Alabama Department of Economic and
Community Affairs
3465 Norman Bridge Road
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Mr. Doug Watson
Economic Development Manager
City of Auburn
Auburn, AL 36830

Auburn University

Auburn University, Alabama 36849-5252

Economic Development Institute
3354 Haley Center

Telephone: (205) 844-4704

April 19, 1989

Mr. ///

Dear ///

Thank you for agreeing to serve on the panel of judges to validate the technical quality of the Higher Education Economic Development Survey (HEEDS). Enclosed you will find a preliminary copy of HEEDS that asks you to determine whether each item is clearly written and whether each item is appropriate to the response scale. In addition, a form has been provided requesting your reactions, comments, or suggestions for improving this survey. I will be pleased to provide a final copy of the study upon request.

The purpose of this study is to develop and validate an instrument to measure the frequency of presently occurring state university and land grant institution activities in economic development. The review of the literature was evaluated by three experts in economic development. Based on your background and expertise, please respond to the survey item technical review by noting yes or no in front of each item.

If possible, I would appreciate receiving your response by May 2, 1989. I have enclosed a self-addressed envelope with first class postage for your convenience. Should you need to talk with me about the validation process of HEEDS, I can be reached most days at (205) 844-4704 between 8:00 a.m. and 5:00 p.m. and most evenings at (205) 245-7537 between 7:00 p.m. and 10:00 p.m. Please feel free to call collect. I appreciate your willingness to assist the Economic Development Institute and myself in completing this research.

Sincerely,

Jim Hethcox

Jim Hethcox
Graduate Research Assistant
Economic Development Institute
3354 Haley Center
Auburn University, AL 36849-5252

Enclosures: Preliminary Higher Education Economic Development Survey

AUBURN UNIVERSITY
edi
ECONOMIC DEVELOPMENT INSTITUTE

Higher Education Economic Development Survey

PART I - Demographics (please check)

1. **Type of Institutional Governance:**
   - ____ Board of Trustees
   - ____ Statewide Regents
   - ____ Other (please note)_____

2. **Respondent's Title:**
   - ____ Cooperative Extension Director/ Administrator
   - ____ Dean of the Graduate School
   - ____ Vice President for Research
   - ____ Other (please note) _____

3. **Undergraduate Major Area:**
   - ____ Agriculture
   - ____ Architecture
   - ____ Business
   - ____ Education
   - ____ Engineering
   - ____ Forestry
   - ____ Liberal Arts
   - ____ Pharmacy
   - ____ Sciences/Mathematics
   - ____ Veterinary Medicine
   - ____ Other (please note)_____

4. **Highest Degree Obtained:**
   - ____ Ed.D.
   - ____ J.D.
   - ____ M.D.
   - ____ Ph.D.
   - ____ Sc.D.
   - ____ Other (please note) _____

5. **Type of Institution Where Highest Degree was Obtained:**
   - ____ Land Grant Institution
   - ____ Private Institution
   - ____ State University
   - ____ Technical Institution (e.g., MIT, RPI, Cal Tech, Ga Tech)
   - ____ Other (please note) _____

6. **Years of Experience:**
   - ____ This Institution
   - ____ Other Institutions

7. **Age:**
   - ____ Under 30
   - ____ 31-40
   - ____ 41-50
   - ____ 51-60
   - ____ 61-65
   - ____ 66 plus

8. **Gender:**
   - ____ Female
   - ____ Male

PART II - Higher Education Economic Development Objectives

Directions: This questionnaire contains 56 items organized into five dimensions of higher education thought important to economic development. Rate each item according to the amount of involvement *presently occurring* at your institution and to what extent you believe the activity *should be occuring*. If you have no knowledge of the activity *presently occurring* please circle "?", however, remember to circle a choice on the *should be occurring* scale.

Range of Time

1. Always 100%
2. Frequently, if not always 75-99%
3. Fairly often 50-74%
4. Sometimes 25-49%
5. Seldom 1-24%
6. Never 0%

To what extent this activity is **Presently Occurring**

No Knowledge of Activity
Always 100%
Frequently 75-99%
Fairly Often 50-74%
Sometimes 25-49%
Seldom 1-24%
Never 0%

To what extent this activity **Should be Occurring**

Always 100%
Frequently 75-99%
Fairly Often 50-74%
Sometimes 25-49%
Seldom 1-24%
Never 0%

Technical Quality of Items
Is the item clearly written and appropriate to the response scale?

A. Human Resource Development:

YES	NO			Presently Occurring							Should be Occurring					
___	___	1.	Recognize public service contributions that promote economic development activities in an instructional reward system in addition to the traditional scholarly engagements	?	1	2	3	4	5	6	1	2	3	4	5	6
___	___	2.	Offer appropriate instruction at flexible times to meet the unique needs of industry, community, and state/ local government in planning for economic development	?	1	2	3	4	5	6	1	2	3	4	5	6
___	___	3.	Utilize advanced telecommunication delivery systems that beam instruction from campus via satellite uplink to the consumer	?	1	2	3	4	5	6	1	2	3	4	5	6
___	___	4.	Provide a pre-school program for families of faculty, staff, and students	?	1	2	3	4	5	6	1	2	3	4	5	6
___	___	5.	Promote an undergraduate foreign language require ment	?	1	2	3	4	5	6	1	2	3	4	5	6
___	___	6.	Promote international studies as a core requirement for undergraduate curricula that enhances knowledge of other cultures	?	1	2	3	4	5	6	1	2	3	4	5	6
___	___	7.	Conduct a junior year abroad foreign exchange program	?	1	2	3	4	5	6	1	2	3	4	5	6
___	___	8.	Provide policies that encourage undergraduate interdepartmental studies	?	1	2	3	4	5	6	1	2	3	4	5	6
___	___	9.	Devise instructional methodologies across curricula that utilize case studies in combination with problem-solving simulations	?	1	2	3	4	5	6	1	2	3	4	5	6

Range of Time	
1. Always	100%
2. Frequently, if not always	75-99%
3. Fairly often	50-74%
4. Sometimes	25-49%
5. Seldom	1-24%
6. Never	0%

To what extent this activity is **Presently Occurring**	
No Knowledge of Activity	?
Always	1
Frequently	2
Fairly Often	3
Sometimes	4
Seldom	5
Never	6

To what extent this activity **Should be Occurring**	
Always	1
Frequently	2
Fairly Often	3
Sometimes	4
Seldom	5
Never	6

YES	NO			Presently Occurring	Should be Occurring
___	___	10.	Encourage academic policy that requires multidisciplinary graduate study within the framework of traditional departments	? 1 2 3 4 5 6	1 2 3 4 5 6
___	___	11.	Establish advisory councils and other linkage mechanisms to keep in touch with community needs	? 1 2 3 4 5 6	1 2 3 4 5 6
___	___	12.	Build capacity through symposia and conferences involving diverse community groups including business, labor, and local government leaders and faculty to address economic development priorities	? 1 2 3 4 5 6	1 2 3 4 5 6
___	___	13.	Educate policy makers and the general public about university resources that could promote local economic development	? 1 2 3 4 5 6	1 2 3 4 5 6

B. Research, Analysis, Evaluation:

___	___	14.	Standardize data bases that can be linked for internal comparison and analysis (e.g., if data bases for academic programs and personnel were linked for a program review, an analysis of tenure density, rank distribution, and retirement probabilities are then possible)	? 1 2 3 4 5 6	1 2 3 4 5 6
___	___	15.	Collect data every term that minimally includes: (a) students, (b) academic programs, (c) facilities, (d) finances, and (e) personnel	? 1 2 3 4 5 6	1 2 3 4 5 6
___	___	16.	Maintain an MIS within the office of institutional research to diagnose problems and analyze alternatives in policy analysis, needs assessment, forecasting, impact predictions, strategic planning, economic development	? 1 2 3 4 5 6	1 2 3 4 5 6
___	___	17.	Evaluate the institutional data base requirements of all personnel throughout the organization who may need to access information for decision making	? 1 2 3 4 5 6	1 2 3 4 5 6
___	___	18.	Establish policies that reflect the needs of all personnel affected by or involved in access to information for decision making	? 1 2 3 4 5 6	1 2 3 4 5 6

Range of Time	
1. Always	100%
2. Frequently, if not always	75-99%
3. Fairly often	50-74%
4. Sometimes	25-49%
5. Seldom	1-24%
6. Never	0%

To what extent this activity is **Presently Occurring**	
0	No Knowledge of Activity
1	Always 100%
2	Frequently 75-99%
3	Fairly Often 50-74%
4	Sometimes 25-49%
5	Seldom 1-24%
6	Never 0%

To what extent this activity **Should be Occurring**	
1	Always 100%
2	Frequently 75-99%
3	Fairly Often 50-74%
4	Sometimes 25-49%
5	Seldom 1-24%
6	Never 0%

YES	NO			Presently Occurring							Should be Occurring						
___	___	19.	Establish guidelines to transform institutional research into a management information system	?	1	2	3	4	5	6	1	2	3	4	5	6
___	___	20.	Provide cooperative extension networks with access to on-campus data bases to diagnose problems and analyze alternative economic development strategies	?	1	2	3	4	5	6	1	2	3	4	5	6
___	___	21.	Maintain a data base of university-industry interaction for longitudinal trend analysis	?	1	2	3	4	5	6	1	2	3	4	5	6
___	___	22.	Maintain an empirical data base for comparison and evaluation of innovation processes between university, industry, community, state and local government interactions	?	1	2	3	4	5	6	1	2	3	4	5	6

C. Capacity Building:

___	___	23.	Advocate a facilities fund dispersed through a National Science Foundation peer review process (50/50 matching) over a 10-year period to bring academic infrastructure up to acceptable research standards	?	1	2	3	4	5	6	1	2	3	4	5	6
___	___	24.	Promote amortization of new academic facilities be reduced from the present 50 years to 20 years	?	1	2	3	4	5	6	1	2	3	4	5	6
___	___	25.	Promote reducing depreciation of equipment/instrumentation from the current 15 years to between 5 and 10 years depending upon the precise nature of the equipment/instrumentation involved	?	1	2	3	4	5	6	1	2	3	4	5	6
___	___	26.	Encourage federally funded research grants be allocated for at least 3 years and preferably 5 years	?	1	2	3	4	5	6	1	2	3	4	5	6
___	___	27.	Advocate greater flexibility of federal funding that allows investigators discretionary use of up to 10% of research monies	?	1	2	3	4	5	6	1	2	3	4	5	6
___	___	28.	Encourage high-risk research of investigators with a proven track record	?	1	2	3	4	5	6	1	2	3	4	5	6
___	___	29.	Advocate federally funded block grants that encourage multidisciplinary and regional university cooperation	?	1	2	3	4	5	6	1	2	3	4	5	6

Range of Time

1. Always 100%
2. Frequently, if not always 75-99%
3. Fairly often 50-74%
4. Sometimes 25-49%
5. Seldom 1-24%
6. Never 0%

YES	NO		To what extent this activity is **Presently Occurring** (No Knowledge of Activity ? · Always 100% 1 · Frequently 75-99% 2 · Fairly Often 50-74% 3 · Sometimes 25-49% 4 · Seldom 1-24% 5 · Never 0% 6)	To what extent this activity **Should be Occurring** (Always 100% 1 · Frequently 75-99% 2 · Fairly Often 50-74% 3 · Sometimes 25-49% 4 · Seldom 1-24% 5 · Never 0% 6)
___	___	30.	Advocate a 25% full tax credit for industrial funding of academic based research ? 1 2 3 4 5 6	1 2 3 4 5 6
___	___	31.	Advocate establishment of a tax deduction equal to the full market value of all industrially contributed equipment/instrumentation ? 1 2 3 4 5 6	1 2 3 4 5 6
___	___	32.	Promote tax credit for industry-supported maintenance and servicing of donated research equipment ? 1 2 3 4 5 6	1 2 3 4 5 6
___	___	33.	Establish advisory councils and other linkage mechanisms to keep abreast of the needs of the service area ? 1 2 3 4 5 6	1 2 3 4 5 6
___	___	34.	Develop centers for excellence that focus on existing service areas in which the institution has expertise ? 1 2 3 4 5 6	1 2 3 4 5 6
___	___	35.	Develop linkage mechanisms between venture capital networks and entrepreneurs ? 1 2 3 4 5 6	1 2 3 4 5 6
___	___	36.	Develop research strategies that monitor potential foreign markets for state industries ? 1 2 3 4 5 6	1 2 3 4 5 6
___	___	37.	Provide mechanisms to encourage faculty assistance to small and medium size firms in export management ? 1 2 3 4 5 6	1 2 3 4 5 6
___	___	38.	Advocate full portable, merit-based scholarships to the most intellectually-able 1% of entering college freshmen ? 1 2 3 4 5 6	1 2 3 4 5 6

D. New Business Development:

___	___	39.	Provide management and technical assistance to potential entrepreneurs including faculty ? 1 2 3 4 5 6	1 2 3 4 5 6
___	___	40.	Provide entrepreneurial assistance programs with emphasis on new business development, i.e., evaluation of technical feasibility, market evaluation, production costs, financial viability, and general business and management advice ? 1 2 3 4 5 6	1 2 3 4 5 6
___	___	41.	Provide industrial extension agents who will work specifically with new and small businesses, e.g., market identification, management training, computer use, exporting, procurement assistance, patent and licensing arrangements ? 1 2 3 4 5 6	1 2 3 4 5 6

Range of Time

1. Always 100%
2. Frequently, if not always 75-99%
3. Fairly often 50-74%
4. Sometimes 25-49%
5. Seldom 1-24%
6. Never 0%

YES	NO		To what extent this activity is **Presently Occurring** (No Knowledge of Activity ? / Always 100% 1 / Frequently 75-99% 2 / Fairly Often 50-74% 3 / Sometimes 25-49% 4 / Seldom 1-24% 5 / Never 0% 6)	To what extent this activity **Should be Occurring** (Always 100% 1 / Frequently 75-99% 2 / Fairly Often 50-74% 3 / Sometimes 25-49% 4 / Seldom 1-24% 5 / Never 0% 6)
___	___	42. Develop mechanisms that stimulate new business development, e.g., incubators, research centers, entrepreneurial training programs, and innovation centers	? 1 2 3 4 5 6	1 2 3 4 5 6
___	___	43. Negotiate prior to actual involvement, expected financial benefits (i.e., royalties, rents, equity ownership) in return for institutional seed money, use of faculty consulting services, office space, and laboratory equipment	? 1 2 3 4 5 6	1 2 3 4 5 6
___	___	44. Set measurable goals for data analyses and evaluation of institutional programs promoting new business for economic development	? 1 2 3 4 5 6	1 2 3 4 5 6

E. Technology Development:

___	___	45. Develop organizational mechanisms for synthesizing faculty research for data processing	? 1 2 3 4 5 6	1 2 3 4 5 6
___	___	46. Maintain a computer data base inventory of all faculty research	? 1 2 3 4 5 6	1 2 3 4 5 6
___	___	47. Provide industries and appropriate government agencies access to relevant faculty research activities specifically for aiding economic development	? 1 2 3 4 5 6	1 2 3 4 5 6
___	___	48. Provide a directory of institutional services that might facilitate product or process technology transfer to businesses, state/local governments, and communities	? 1 2 3 4 5 6	1 2 3 4 5 6
___	___	49. Develop a specific program for diffusion of university technological products and processes for economic development	? 1 2 3 4 5 6	1 2 3 4 5 6
___	___	50. Provide knowledge transfer mechanisms that support industrial professional and community economic development needs	? 1 2 3 4 5 6	1 2 3 4 5 6
___	___	51. Provide a campus-wide interactive data base which includes information on faculty research activities	? 1 2 3 4 5 6	1 2 3 4 5 6

Range of Time	
1. Always	100%
2. Frequently, if not always	75-99%
3. Fairly often	50-74%
4. Sometimes	25-49%
5. Seldom	1-24%
6. Never	0%

To what extent this activity is **Presently Occurring**	
No Knowledge of Activity	?
Always	1
Frequently	2
Fairly Often	3
Sometimes	4
Seldom	5
Never	6

To what extent this activity **Should be Occurring**	
Always	1
Frequently	2
Fairly Often	3
Sometimes	4
Seldom	5
Never	6

YES	NO														
___	___	52. Promote faculty sabbaticals in laboratory settings, e.g., industry, economic development agencies, federal laboratories	?	1	2	3	4	5	6	1	2	3	4	5	6
___	___	53. Encourage faculty access to industrial and federal laboratories in personnel exchanges that also allow laboratory scientists to teach in classrooms for one term	?	1	2	3	4	5	6	1	2	3	4	5	6
___	___	54. Establish specific institutional guidelines for faculty consulting regarding conflicts of interest and academic freedom	?	1	2	3	4	5	6	1	2	3	4	5	6
___	___	55. Provide equitable compensation for faculty consulting and reward public service contributions that contribute to economic development	?	1	2	3	4	5	6	1	2	3	4	5	6
___	___	56. Develop mechanisms to facilitate product commercialization through patent filing, patent management, and patent licensing	?	1	2	3	4	5	6	1	2	3	4	5	6

Please respond with reactions, comments, or suggestions to the following aspects of the instrument:

1. Are there economic development issues not included which should have been in a survey of administrators in higher education?

2. Are there suggestions for improvement of the instrument's directions?

3. Are there other suggestions or comments for improving the Higher Education Economic Development Survey (HEEDS)?

APPENDIX D

SAMPLE OF HEEDS, DEFINITION OF TERMS, AND COVER LETTER

UNIVERSITY OF CALIFORNIA, IRVINE

BERKELEY • DAVIS • IRVINE • LOS ANGELES • RIVERSIDE • SAN DIEGO • SAN FRANCISCO SANTA BARBARA • SANTA CRUZ

OFFICE OF THE CHANCELLOR EMERITUS
IRVINE, CALIFORNIA 92717

May 1, 1989

Dear Research Administrator:

This decade has seen a rise in local, state, and regional economic development initiatives. While these initiatives have originated from various and diverse sources, this study is concerned with the role of higher educations' current involvement in economic development.

The Auburn University Economic Development Institute is developing an instrument to gauge the current involvement of state universities and land-grant institutions in economic development as perceived by research administrators. The attached survey instrument concerned with frequency measures of state universities and land-grant institutions economic development activities is part of a nationwide study. The project is concerned specifically with determining those activities presently occurring and those that should be occurring in our nation.

The results of this study will be used for establishing a set of norms representing the status of economic development in higher education with respect to presently occurring activities and for providing a basis for further research in the area of higher education economic development.

We are particularly desirous of obtaining your responses because your expertise as a research administrator will contribute significantly toward understanding some of the problems we face regarding the relationship of economic development to education. The enclosed instrument has been tested with a sampling of knowledgeable professionals, and we have revised it in order to make it possible for us to obtain all necessary data while requiring a minimum of your time. For example, at the bottom of each survey is a six digit Integrated Postsecondary Education Data System (IPEDS) number identifying your institution for the purpose of future demographic comparison on the basis of institutional characteristics, i.e., library holdings, student population, etc., and thus eliminating the need for your to do any more than necessary. In addition, a definition of terms used in HEEDS has been included for consistency.

If you will complete and fold the enclosed pre-addressed, stamped survey prior to May 31, 1989, other phases of this research can be carried out. We welcome any comments that you may have concerning any aspect of economic development not covered in the instrument. Your responses will be held in strictest confidence.

We will be pleased to send you a summary of the survey results if you desire. Thank you for your cooperation.

Daniel G. Aldrich

Daniel G. Aldrich
Chancellor Emeritus

Definition of Terms

Capacity Building (also referred to as capacity-creating aspect of investment): An effect of investment spending on the productive capacity (ability to produce goods and services) of an economy. An efficient and effective supply and coordination of human resources and infrastructure in the development of markets and the involvement of entrepreneurs are essential steps in capacity building for economic development.

Development: The systematic use of knowledge or understanding gained from research, directed toward the production of useful materials, devices, systems or methods, including design and development of prototypes and processes.

Economic Development: The process through which an economy achieves long-run economic growth; involves capital formation, the development of markets, productivity growth, and the improvement of entrepreneurial ability and labor skills.

Human Resource Development: The tailoring of continual education to meet the human resource requirements of a global economy in a state of rapid technological change.

Infrastructure (also referred to as capital infrastructure): Composed of seven critical elements for economic development: (a) transportation, (b) finance and legal institutions, (c) energy, (d) communications, (e) capital goods and equipment, (f) research and development, and (g) human resources.

Research: Basic and applied work to produce new knowledge that can result in new products and services or improved forms of production.

Technical Assistance: The application of existing knowledge that enables the recipient to learn about and adopt effective management and engineering concepts.

Technology: A body of scientific, technical, and managerial knowledge developed by an individual or group to introduce new products and processes.

Technology Development: Technology Development includes three distinct steps: (a) invention - the act of conception that requires a knowledge of available technological resources and an understanding of society's wants and needs; (b) innovation - the introduction of new ideas, processes, or inventions into the economy of society that requires investment of money or resources, and services of entrepreneurs, and usually involves substantial risk; and (c) diffusion - an educational/informational transfer process spreading new technology throughout the whole industry or to other industries and disciplines.

continued on back

Technology Transfer: The process by which new technologies are diffused an adopted throughout the economy. The term can be used to describe a information exchange function -- a process by which technology developed in on organization, in one area, or for one purpose -- or a commercialization functio -- the process by which an idea or invention becomes a marketable good o service. It is vital to economic growth since the major benefits of technology de velopment will be experienced when new discoveries are introduced into th existing business sector.

Citations for each item on this survey instrument are available upon request from t Economic Development Institute, 3354 Haley Center, Auburn University, Alaba 36849_5252 or from University Microfilms International, 300 North Zeeb Road, A Arbor, Michigan 48106.

AUBURN UNIVERSITY
edi
ECONOMIC DEVELOPMENT INSTITUTE

Higher Education Economic Development Survey

PART I - Demographics (please check)

1. **Type of Institutional Governance:**
   - ____ Board of Trustees
   - ____ Statewide Regents
   - ____ Other (please note)_____

2. **Respondent's Title:**
   - ____ Cooperative Extension Director/ Administrator
   - ____ Dean of the Graduate School
   - ____ Vice President for Research
   - ____ Other (please note) _____

3. **Undergraduate Major Area:**
   - ____ Agriculture
   - ____ Architecture
   - ____ Business
   - ____ Education
   - ____ Engineering
   - ____ Forestry
   - ____ Liberal Arts
   - ____ Pharmacy
   - ____ Sciences/Mathematics
   - ____ Veterinary Medicine
   - ____ Other (please note)_____

4. **Highest Degree Obtained:**
   - ____ Ed.D.
   - ____ J.D.
   - ____ M.D.
   - ____ Ph.D.
   - ____ Sc.D.
   - ____ Other (please note) _____

5. **Type of Institution Where Highest Degree was Obtained:**
   - ____ Land Grant Institution
   - ____ Private Institution
   - ____ State University
   - ____ Technical Institution (e.g., MIT, RPI, Cal Tech, Ga Tech)
   - ____ Other (please note) _____

6. **Years of Experience:**
   - ____ This Institution (present position)
   - ____ Other Institutions (similar position)

7. **Age:**
   - ____ Under 30
   - ____ 31-40
   - ____ 41-50
   - ____ 51-60
   - ____ 61-65
   - ____ 66 plus

8. **Gender:**
   - ____ Female
   - ____ Male

PART II - Higher Education Economic Development Objectives

Directions: This questionnaire contains 56 items organized into five theoretical dimensions of higher education thought important to economic development. Rate each item according to the amount of involvement *presently occurring* at your institution and to what extent you believe the activity *should be occuring*. If you have no knowledge of the activity *presently occurring* please circle "7", however, remember to circle a choice on the *should be occurring* scale.

Range of Time

1. Always 100%
2. Frequently, if not always 75-99%
3. Fairly often 50-74%
4. Sometimes 25-49%
5. Seldom 1-24%
6. Never 0%

To what extent this activity is **Presently Occurring**

7 No Knowledge of Activity
6 Always 100%
5 Frequently 75-99%
4 Fairly Often 50-74%
3 Sometimes 25-49%
2 Seldom 1-24%
1 Never 0%

To what extent this activity **Should be Occurring**

6 Always 100%
5 Frequently 75-99%
4 Fairly Often 50-74%
3 Sometimes 25-49%
2 Seldom 1-24%
1 Never 0%

A. Human Resource Development:

		Presently Occurring							Should be Occurring					
1.	Recognize public service contributions that promote economic development activities in an instructional reward system in addition to the traditional scholarly engagements	?	1	2	3	4	5	6	1	2	3	4	5	6
2.	Offer appropriate instruction at flexible times to meet the unique needs of industry, community, and state/local government in planning for economic development	?	1	2	3	4	5	6	1	2	3	4	5	6
3.	Utilize advanced telecommunication delivery systems that provide instruction from campus via satellite uplink to the off-campus student	?	1	2	3	4	5	6	1	2	3	4	5	6
4.	Provide a pre-school program for families of faculty, staff, and students	?	1	2	3	4	5	6	1	2	3	4	5	6
5.	Promote an undergraduate foreign language requirement	?	1	2	3	4	5	6	1	2	3	4	5	6
6.	Promote international studies that enhance knowledge of other cultures as a core requirement for undergraduate curricula	?	1	2	3	4	5	6	1	2	3	4	5	6
7.	Conduct a junior year abroad foreign exchange program	?	1	2	3	4	5	6	1	2	3	4	5	6
8.	Encourage undergraduate interdepartmental studies	?	1	2	3	4	5	6	1	2	3	4	5	6
9.	Devise instructional methodologies across curricula that utilize multidisciplinary case studies in combination with problem-solving simulations	?	1	2	3	4	5	6	1	2	3	4	5	6

Range of Time	
1. Always	100%
2. Frequently, if not always	75-99%
3. Fairly often	50-74%
4. Sometimes	25-49%
5. Seldom	1-24%
6. Never	0%

	To what extent this activity is Presently Occurring							To what extent this activity Should be Occurring					
	No Knowledge of Activity	Always — 100%	Frequently — 75-99%	Fairly Often — 50-74%	Sometimes — 25-49%	Seldom — 1-24%	Never — 0%	Always — 100%	Frequently — 75-99%	Fairly Often — 50-74%	Sometimes — 25-49%	Seldom — 1-24%	Never — 0%
10. Encourage academic policy that requires multidisciplinary graduate study within the framework of traditional departments	?	1	2	3	4	5	6	1	2	3	4	5	6
11. Establish advisory councils and other linkage mechanisms to keep in touch with community needs	?	1	2	3	4	5	6	1	2	3	4	5	6
12. Build capacity to address economic development priorities through symposia and conferences involving diverse community groups including business, labor, and local government leaders and faculty	?	1	2	3	4	5	6	1	2	3	4	5	6
13. Educate policy makers and the general public about university resources that could promote local economic development	?	1	2	3	4	5	6	1	2	3	4	5	6

B. Research, Analysis, Evaluation:

14. Standardize data bases that can be linked for internal comparison and analysis (e.g., if data bases for academic programs and personnel were linked for a program review, an analysis of tenure density, rank distribution, and retirement probabilities are then possible)	?	1	2	3	4	5	6	1	2	3	4	5	6
15. Collect data every academic term that includes: (a) students, (b) academic programs, (c) facilities, (d) finances, and (e) personnel	?	1	2	3	4	5	6	1	2	3	4	5	6
16. Maintain an MIS within the office of institutional research to diagnose problems and analyze alternatives in policy analysis, needs assessment, forecasting, impact predictions, strategic planning, economic development	?	1	2	3	4	5	6	1	2	3	4	5	6
17. Evaluate the institutional data base requirements of all personnel throughout the organization who need to access information for decision making	?	1	2	3	4	5	6	1	2	3	4	5	6
18. Establish policies that reflect the needs of all personnel affected by or involved in access to information for decision making	?	1	2	3	4	5	6	1	2	3	4	5	6

Range of Time	
1.	Always 100%
2.	Frequently, if not always 75-99%
3.	Fairly often 50-74%
4.	Sometimes 25-49%
5.	Seldom 1-24%
6.	Never 0%

To what extent this activity is Presently Occurring	To what extent this activity Should be Occurring
No Knowledge of Activity	
Always 100%	Always 100%
Frequently 75-99%	Frequently 75-99%
Fairly Often 50-74%	Fairly Often 50-74%
Sometimes 25-49%	Sometimes 25-49%
Seldom 1-24%	Seldom 1-24%
Never 0%	Never 0%

19.	Establish guidelines to transform institutional research into a management information system	?	1	2	3	4	5	6	1	2	3	4	5	6
20.	Provide cooperative extension networks with access to on-campus data bases to diagnose problems and analyze alternative economic development strategies	?	1	2	3	4	5	6	1	2	3	4	5	6
21.	Maintain a data base of university-industry interaction for longitudinal trend analysis	?	1	2	3	4	5	6	1	2	3	4	5	6
22.	Maintain an empirical data base for comparison and evaluation of innovation processes among university, industry, community, state and local government	?	1	2	3	4	5	6	1	2	3	4	5	6

C. Capacity Building:

23.	Advocate a facilities fund dispersed through a National Science Foundation peer review process (50/50 matching) over a 10-year period to bring academic infrastructure up to acceptable research standards	?	1	2	3	4	5	6	1	2	3	4	5	6
24.	Promote amortization of new academic facilities be reduced from the present 50 years to 20 years	?	1	2	3	4	5	6	1	2	3	4	5	6
25.	Promote reducing depreciation of equipment/instrumentation from the current 15 years to between 5 and 10 years depending upon the precise nature of the equipment/instrumentation involved	?	1	2	3	4	5	6	1	2	3	4	5	6
26.	Encourage allocation of federally funded research grants for at least 3 to 5 years	?	1	2	3	4	5	6	1	2	3	4	5	6
27.	Advocate greater flexibility of federal funding that allows investigators discretionary use of up to 10% of research monies	?	1	2	3	4	5	6	1	2	3	4	5	6
28.	Encourage high-risk research by investigators with a proven track record	?	1	2	3	4	5	6	1	2	3	4	5	6
29.	Advocate federally funded block grants that encourage multidisciplinary and regional university cooperation	?	1	2	3	4	5	6	1	2	3	4	5	6

Range of Time	
1.	Always 100%
2.	Frequently, if not always 75-99%
3.	Fairly often 50-74%
4.	Sometimes 25-49%
5.	Seldom 1-24%
6.	Never 0%

		To what extent this activity is Presently Occurring							To what extent this activity Should be Occurring					
		No Knowledge of Activity	Always 100%	Frequently 75-99%	Fairly Often 50-74%	Sometimes 25-49%	Seldom 1-24%	Never 0%	Always 100%	Frequently 75-99%	Fairly Often 50-74%	Sometimes 25-49%	Seldom 1-24%	Never 0%
30.	Advocate a 25% full tax credit for industrial funding of academic based research	?	1	2	3	4	5	6	1	2	3	4	5	6
31.	Advocate establishment of a tax deduction equal to the full market value of all industrially contributed equipment/instrumentation	?	1	2	3	4	5	6	1	2	3	4	5	6
32.	Promote tax credit for industry-supported maintenance and servicing of donated research equipment	?	1	2	3	4	5	6	1	2	3	4	5	6
33.	Establish advisory councils and other linkage mechanisms to keep abreast of the needs of the service area	?	1	2	3	4	5	6	1	2	3	4	5	6
34.	Develop centers for excellence that focus on existing service areas in which the institution has expertise	?	1	2	3	4	5	6	1	2	3	4	5	6
35.	Develop linkage mechanisms between venture capital networks and entrepreneurs	?	1	2	3	4	5	6	1	2	3	4	5	6
36.	Develop research strategies that monitor potential foreign markets for state industries	?	1	2	3	4	5	6	1	2	3	4	5	6
37.	Provide mechanisms to encourage faculty assistance to small and medium size firms in export management	?	1	2	3	4	5	6	1	2	3	4	5	6
38.	Advocate full, portable, merit-based scholarships to the most intellectually-able 1% of entering college freshmen	?	1	2	3	4	5	6	1	2	3	4	5	6

D. New Business Development:

39.	Provide management and technical assistance to potential entrepreneurs	?	1	2	3	4	5	6	1	2	3	4	5	6
40.	Provide entrepreneurial assistance programs with emphasis on new business development, i.e., evaluation of technical feasibility, market evaluation, production costs, financial viability, and general business and management advice	?	1	2	3	4	5	6	1	2	3	4	5	6
41.	Provide industrial extension agents who will work specifically with new and small businesses in market identification, management training, computer use, exporting, procurement assistance, patent and licensing arrangements	?	1	2	3	4	5	6	1	2	3	4	5	6

Range of Time	
1. Always	100%
2. Frequently, if not always	75-99%
3. Fairly often	50-74%
4. Sometimes	25-49%
5. Seldom	1-24%
6. Never	0%

	To what extent this activity is **Presently Occurring**							To what extent this activity **Should be Occurring**					
	No Knowledge of Activity	Always 100%	Frequently 75-99%	Fairly Often 50-74%	Sometimes 25-49%	Seldom 1-24%	Never 0%	Always 100%	Frequently 75-99%	Fairly Often 50-74%	Sometimes 25-49%	Seldom 1-24%	Never 0%
42. Develop mechanisms that stimulate new business development, e.g., incubators, research centers, entrepreneurial training programs, and innovation centers	?	1	2	3	4	5	6	1	2	3	4	5	6
43. Negotiate outside grants and contracts prior to actual involvement, expected financial benefits (i.e., royalties, rents, equity ownership) in return for institutional seed money, use of faculty consulting services, office space, and laboratory equipment	?	1	2	3	4	5	6	1	2	3	4	5	6
44. Set measurable goals for data analyses and evaluation of institutional programs promoting new business for economic development	?	1	2	3	4	5	6	1	2	3	4	5	6

E. Technology Development:

45. Develop organizational mechanisms for synthesizing faculty research for data processing	?	1	2	3	4	5	6	1	2	3	4	5	6
46. Maintain a computer data base inventory of all faculty research	?	1	2	3	4	5	6	1	2	3	4	5	6
47. Provide industries and appropriate government agencies access to relevant faculty research activities specifically for aiding economic development	?	1	2	3	4	5	6	1	2	3	4	5	6
48. Provide a directory of institutional services that might facilitate product or process technology transfer to businesses, state/local governments, and communities	?	1	2	3	4	5	6	1	2	3	4	5	6
49. Develop a specific program for diffusion of university technological products and processes for economic development	?	1	2	3	4	5	6	1	2	3	4	5	6
50. Provide knowledge transfer mechanisms that support industrial, professional and community economic development needs	?	1	2	3	4	5	6	1	2	3	4	5	6
51. Provide a campus-wide interactive data base which includes information on faculty research activities	?	1	2	3	4	5	6	1	2	3	4	5	6

Range of Time	
1.	Always 100%
2.	Frequently, if not always 75-99%
3.	Fairly often 50-74%
4.	Sometimes 25-49%
5.	Seldom 1-24%
6.	Never 0%

	To what extent this activity is Presently Occurring							To what extent this activity Should be Occurring						
	No Knowledge of Activity	Always 100%	Frequently 75-99%	Fairly Often 50-74%	Sometimes 25-49%	Seldom 1-24%	Never 0%	Always 100%	Frequently 75-99%	Fairly Often 50-74%	Sometimes 25-49%	Seldom 1-24%	Never 0%
52. Promote faculty sabbaticals in laboratory settings, e.g., industry, economic development agencies, federal laboratories	?	1	2	3	4	5	6	1	2	3	4	5	6
53. Encourage faculty access to industrial and federal laboratories through personnel exchanges that allow laboratory scientists to teach in classrooms for one term	?	1	2	3	4	5	6	1	2	3	4	5	6
54. Establish specific institutional guidelines for faculty consulting regarding conflicts of interest and academic freedom	?	1	2	3	4	5	6	1	2	3	4	5	6
55. Provide equitable compensation for faculty consulting, and reward public service contributions that enhance economic development	?	1	2	3	4	5	6	1	2	3	4	5	6
56. Develop mechanisms to encourage product commercialization through patent filing, patent management, and patent licensing	?	1	2	3	4	5	6	1	2	3	4	5	6

Citations for each item on this survey instrument are available upon request from the Economic Development Institute, 3354 Haley Center, Auburn University, Alabama 36849-5252 or from University Microfilms International, 300 North Zeeb Road, Ann Arbor, Michigan 48106.

I am interested in the results of this survey. **Yes** ☐ **No** ☐

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Address: _____

_____

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APPENDIX E

VARIMAX STANDARDIZED SCORING COEFFICIENTS

WITH KAISER'S MSA

VARIMAX Standardized Scoring Coefficients, and Kaiser's Measures of Sampling Adequacy (MSA)

Item	Factor1	Factor2	Factor3	Factor4	Factor5	MSA
1	-0.041	-0.029	0.002	0.085	0.065	.775
2	-0.047	-0.042	0.025	0.108	0.042	.873
3	0.018	0.015	-0.001	0.046	-0.041	.856
4	0.028	-0.014	0.003	0.049	-0.044	.845
5	0.037	-0.036	-0.036	0.089	-0.047	.709
6	0.048	-0.057	-0.064	0.143	0.007	.772
7	0.039	0.009	-0.023	0.067	-0.070	.718
8	0.037	-0.058	-0.054	0.211	-0.070	.814
9	-0.000	-0.044	-0.005	0.055	0.033	.792
10	-0.023	-0.019	0.020	0.189	-0.018	.885
11	-0.025	-0.077	0.040	0.107	0.056	.867
12	-0.040	-0.170	0.027	0.113	0.038	.854
13	-0.072	0.006	0.014	0.123	0.034	.876
14	0.005	0.009	0.049	0.030	-0.066	.802
15	-0.004	0.020	0.071	0.006	-0.043	.859
16	-0.017	-0.027	0.087	0.018	-0.012	.822
17	-0.036	-0.018	0.326	0.013	-0.095	.848
18	-0.015	-0.010	0.117	0.001	-0.049	.847
19	-0.010	-0.066	0.180	0.003	-0.007	.820
20	-0.025	0.012	0.086	-0.057	0.032	.848
21	-0.037	0.043	0.120	-0.041	-0.040	.834
22	-0.042	0.001	0.235	-0.063	-0.052	.807
23	0.105	0.049	-0.012	-0.010	-0.089	.905
24	0.144	-0.021	0.005	-0.042	-0.020	.881
25	0.123	-0.023	-0.024	0.031	-0.041	.831
26	0.111	0.048	-0.052	0.074	-0.169	.914
27	0.109	0.063	-0.012	0.040	-0.119	.921
28	0.096	0.078	-0.067	0.054	-0.125	.935
29	0.077	0.006	0.007	0.001	-0.021	.897
30	0.062	-0.057	0.029	-0.028	0.086	.899
31	0.214	-0.190	0.077	-0.146	0.226	.864
32	0.175	-0.078	-0.091	-0.024	0.177	.887
33	-0.023	-0.023	0.055	0.040	0.089	.903
34	-0.000	0.012	-0.020	0.081	0.004	.900
35	-0.028	0.003	0.003	0.005	0.105	.877
36	0.019	-0.038	0.043	-0.039	0.112	.869
37	0.033	-0.007	0.008	-0.014	0.085	.911
38	0.066	0.029	-0.043	-0.005	-0.009	.930
39	-0.008	-0.001	-0.026	0.004	0.167	.868
40	-0.016	-0.015	-0.083	0.025	0.265	.841
41	-0.007	0.034	-0.045	0.021	0.073	.903
42	-0.032	0.054	-0.039	0.001	0.126	.912
43	-0.016	0.046	0.011	-0.038	0.030	.879
44	0.011	0.065	0.014	-0.083	0.030	.887
45	0.018	0.040	0.030	-0.042	0.016	.883

(Continued)

Item	Factor1	Factor2	Factor3	Factor4	Factor5	MSA
46	0.022	0.120	0.005	-0.041	-0.057	.842
47	-0.010	0.082	-0.020	-0.018	0.023	.929
48	-0.038	0.143	-0.002	-0.015	-0.033	.909
49	-0.029	0.114	-0.073	-0.009	0.066	.873
50	-0.058	0.159	0.019	-0.024	0.060	.899
51	-0.034	0.128	-0.002	-0.068	-0.052	.833
52	0.001	0.123	-0.022	0.011	-0.058	.890
53	0.006	0.084	-0.055	-0.000	-0.048	.800
54	0.002	0.064	-0.004	-0.004	-0.021	.876
55	-0.028	0.064	-0.004	0.014	0.019	.899
56	-0.008	0.183	-0.019	-0.043	-0.079	.901

OVER-ALL MSA = 0.870

APPENDIX F

THEORETICAL FACTORS OF HEEDS DEFINED BY INSTRUMENT ITEM NUMBERS

Theoretical Factors of HEEDS Defined by Instrument Item Numbers

HRD Factor 1	RAE Factor 2	CB Factor 3	NBD Factor 4	TD Factor 5
1	14	23	39	45
2	15	24	40	46
3	16	25	41	47
4	17	26	42	48
5	18	27	43	49
6	19	28	44	50
7	20	29		51
8	21	30		52
9	22	31		53
10		32		54
11		33		55
12		34		56
13		35		
		36		
		37		
		38		

APPENDIX G

RELIABILITY ESTIMATES OF A PRIORI THEORETICAL FACTORS

Reliability Estimates of A Priori Theoretical Factors

Source	Analysis of Variance — Full Scale			
	SS	DF	MS	F
BETWEEN	8830.	182	48.51	
WITHIN	26069.	10065	2.59	
MEAS	1727.	55	31.41	12.9176*
RES	24341.	10010	2.43	
TOTAL	34899.	10247	3.40	

GRAND MEAN = 3.157

RELIABILITY COEFFICIENTS FOR THEORETICAL SCALES
N OF CASES = 183.0
N OF ITEMS = 56
ALPHA = 0.9499

*Probability less than .0000

Source	Analysis of Variance — Human Resource Development			
	SS	DF	MS	F
BETWEEN	1766.	182	9.70	
WITHIN	4105.	2196	1.86	
MEAS	238.	12	19.90	11.2439*
RES	3866.	2184	1.77	
TOTAL	5871.	2378	2.46	

GRAND MEAN = 3.375

RELIABILITY COEFFICIENTS FOR THEORETICAL SCALES
N OF CASES = 183.0
N OF ITEMS = 13
ALPHA = 0.8175

*Probability less than .0000

(continued)

Source	Analysis of Variance Research, Analysis, Evaluation			
	SS	DF	MS	F
BETWEEN	2480.	182	13.62	
WITHIN	3327.	1464	2.27	
MEAS	408.	8	51.00	25.4356*
RES	2919.	1464	2.00	
TOTAL	5807.	1646	3.52	

GRAND MEAN = 3.131

RELIABILITY COEFFICIENTS FOR THEORETICAL SCALES
N OF CASES = 183.0
N OF ITEMS = 9
ALPHA = 0.8529

*Probability less than .0000

Source	Analysis of Variance Capacity Building			
	SS	DF	MS	F
BETWEEN	5871.	182	32.26	
WITHIN	6998.	2745	2.54	
MEAS	357.	15	23.80	9.7869*
RES	6641.	2730	2.43	
TOTAL	12869.	2927	4.39	

GRAND MEAN = 2.917

RELIABILITY COEFFICIENTS FOR THEORETICAL SCALES
N OF CASES = 183.0
N OF ITEMS = 16
ALPHA = .9246

*Probability less than .0000

(Continued)

Source	Analysis of Variance New Business Development			
	SS	DF	MS	F
BETWEEN	1597.	182	8.77	
WITHIN	1850.	915	2.02	
MEAS	74.	5	14.89	7.6281*
RES	1776.	910	1.95	
TOTAL	3448.	1097	3.14	

GRAND MEAN = 3.365

RELIABILITY COEFFICIENTS FOR THEORETICAL SCALES
N OF CASES = 183.
N OF ITEMS = 6
ALPHA = .7776

*Probability less than .0000

Source	Analysis of Variance Technology Development			
	SS	DF	MS	F
BETWEEN	2563.	182	14.08	
WITHIN	4008.	2013	1.99	
MEAS	318.	11	28.99	15.7331*
RES	3689.	2002	1.84	
TOTAL	6571.	2195	2.99	

GRAND MEAN = 3.156

RELIABILITY COEFFICIENTS FOR THEORETICAL SCALES
N OF CASES = 183.
N OF ITEMS = 12
ALPHA = .8692

*Probability less than .0000